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BULLETIN OF THE TORREY BOTANICAL CLUB
VOL. 75, No. 6, pp. 597–603 DECEMBER, 1948

REGENERATION IN THE MEGAGAMETOPHYTE OF ZAMIA FLORIDANA[1]

CARL D. LARUE

Apogamy and apospory, in the Bryophyta and the Pteridophyta, have been under investigation for a long time and have engaged the attention of numerous workers (6). Apospory in mosses has often been found occurring naturally, and has been induced in numerous species by several workers. Apparently, apogamy has been reported in only one species of moss, *Phascum cuspidatum* (6). Apospory and apogamy have been reported in a number of species of ferns and Jeffrey (4) found evidence of apogamy in *Botrychium virginianum* in the presence of tracheids in the gametophyte. In his paper on the gametophyte of *Botrychium virginianum* Jeffrey suggests also that it would be interesting to know whether apogamy occurs in the cycads. Indeed, it seems that the studies in the Bryophyta and Pteridophyta lead logically to an investigation of the possibility of inducing apogamy in the Gymnospermae, but, apparently, no one had embarked upon it, until, some years since, the writer began to investigate regeneration in the megagametophyte of *Zamia floridana*. Later he discovered that Duchartre (1) had described the production of roots on gametophytes of *Cycas Thouarsii* R.Br. which were without embryos and had lain overlong in the germination bed. This observation was made too early for Duchartre to understand its full significance and until this time it has remained practically unnoted by others.

Methods. Fresh cones of *Zamia floridana* were secured from Florida and the ovules were cultured on nutrient solutions in screw-capped glass bottles. The ovules were sterilized for 20 minutes in a 20 per cent solution of commercial "Clorox" or of "Roman Cleanser." They were opened with a sterile knife and the gametophytes were lifted out and laid on the surface of nutrient agar. Early stages of ovule development offered no difficulty in the removal of the integument but the stony layer of the integument of ripe seeds made the removal of the gametophytes very difficult They were best treated by removing all the fleshy layer and allowing the stony layer to dry until it could be cracked open. The parchment-like nucellus was then removed and the gametophyte sterilized and cultured.

[1] Paper No. 762 from the Department of Botany, University of Michigan. A portion of this work was done at the University of Michigan Biological Station. This research was aided by a grant from the Horace Rackham Research Fund. Thanks are due to Professor F. W. Weber of the University of Florida for furnishing ovules of *Zamia floridana*.

[The Bulletin for September-October (75: 469–596) was issued July 26, 1948]

Gametophytes of various ages were tried, from very early stages to those of ripe ovules. Halves of gametophytes, quarters, and smaller pieces of various dimensions were put in culture.

For the greater number of the cultures White's solution (7) was used, commonly with 0.8 to 1 per cent agar-agar, although trials were made without agar-agar. In recent trials with young gametophytes the tobacco and sunflower media of Hildebrandt, Riker and Duggar (3) were used. Some cultures were made without any minerals.

Sucrose and dextrose were used in culture solutions in concentrations ranging from 1 to 10 per cent, but trials were made without any sugar.

The cultures were kept at ordinary room temperature. Some were exposed to weak light in the laboratory; some to north light near a window; some were placed in full light in a greenhouse, and some in total darkness.

Results. *Effects of cultural conditions.* It cannot be stated that any particular nutrient solution, or any method of treatment has been of special importance. Gametophytes excised at the fertilization stage, or later, are densely packed with starch and it is not surprising that an addition of sugar is not needed. There is no evidence that additions of minerals are needed either, but an adequate water supply is essential.

For young gametophytes sugar and minerals may be needed, but so little success has been obtained in growing them that no conclusions should be drawn.

The cultures seem indifferent also to the presence or absence of light.

Growth. Very young gametophytes grew very little and soon perished. Those transferred to culture about one month before the fertilization stage usually doubled their original size. Those transferred at the fertilization stage, or later, grew slowly and steadily for a long time. Eventually many of them reached a volume 4 or 5 times that which they processed at the time of transfer. Whether the growth was due merely to increased cell size, to augmented numbers of cells, or to both, has not been determined.

Small pieces of gametophyte usually died very soon, and nothing like a continuing tissue culture has been developed.

Differentiation. Many specimens showed no change in appearance save that of increased size. A very few developed chlorophyll in their superficial layers after long exposure to weak light. Exposure to direct sunlight did not stimulate chlorophyll formation in a higher percentage of gametophytes than north light in the laboratory. Chlorophyll had no apparent effect on either growth or regeneration.

Cork formation. Approximately one half the gametophytes showed extensive formation of cork. This appeared first in the form of pustules resembling intumescences and sometimes proceeded no further. But in most

instances the process went on until the gametophyte was covered almost completely by loose periderm which turned brown with age.

Microtome sections of gametophytes show that the periderm is not confined to the surfaces but that plates of this tissue may be formed in successive layers inward almost to the center of the structures. The process of periderm development is very similar to that in the endosperm of *Crinum* as described by Merry (5), but in *Crinum* periderm is formed only under superficial layers of cells.

Endosperm cells. At the fertilization stage and at all later stages the cells of *Zamia* gametophyte are closely packed with starch grains. After long growth in vitro these starch grains have disappeared from the cells except those which lie in islands isolated by sheets of periderm. These latter cells are as full of starch as they were at the beginning of the culture. Otherwise, maintenance in culture produces no obvious change in gametophytic cells.

Regeneration. Regeneration has been most frequent in endosperms excised from ovules at about the fertilization stage. Later stages of gametophytes up to those from fully ripe ovules have not regenerated at all. Young ovules, approximately two months before fertilization, have yielded gametophytes which occasionally have produced buds in the remarkably short time of three months. Ovules excised a month later have formed roots and buds within five months. Gametophytes excised at or near the fertilization stage have required approximately a year to form roots or shoots.

The percentage of gametophytes which have formed roots, shoots, or both, has been very small. An exact count has not been made but probably less than one gametophyte in a hundred has shown regeneration. This estimate considers the gametophytes alive and healthy at the end of a year's growth in culture.

The regenerated structures appeared at first as a pustular mass on the surface of the gametophyte. These arose at random, apparently, on any part of the gametophyte except that they were decidedly more common in a ring around the pore from which the root of the seedling would emerge upon germination.

Although most outgrowths appeared on the uninjured surface of the gametophyte they were seen to arise also on the surfaces of cuts on halves of gametophytes.

Microscopic sections of the early primordia of roots and shoots show masses of meristematic cells not yet definitely organized. These are inconspicuous and may have developed on many gametophytes where they were not detected.

With further development, the outgrowths could be identified as roots

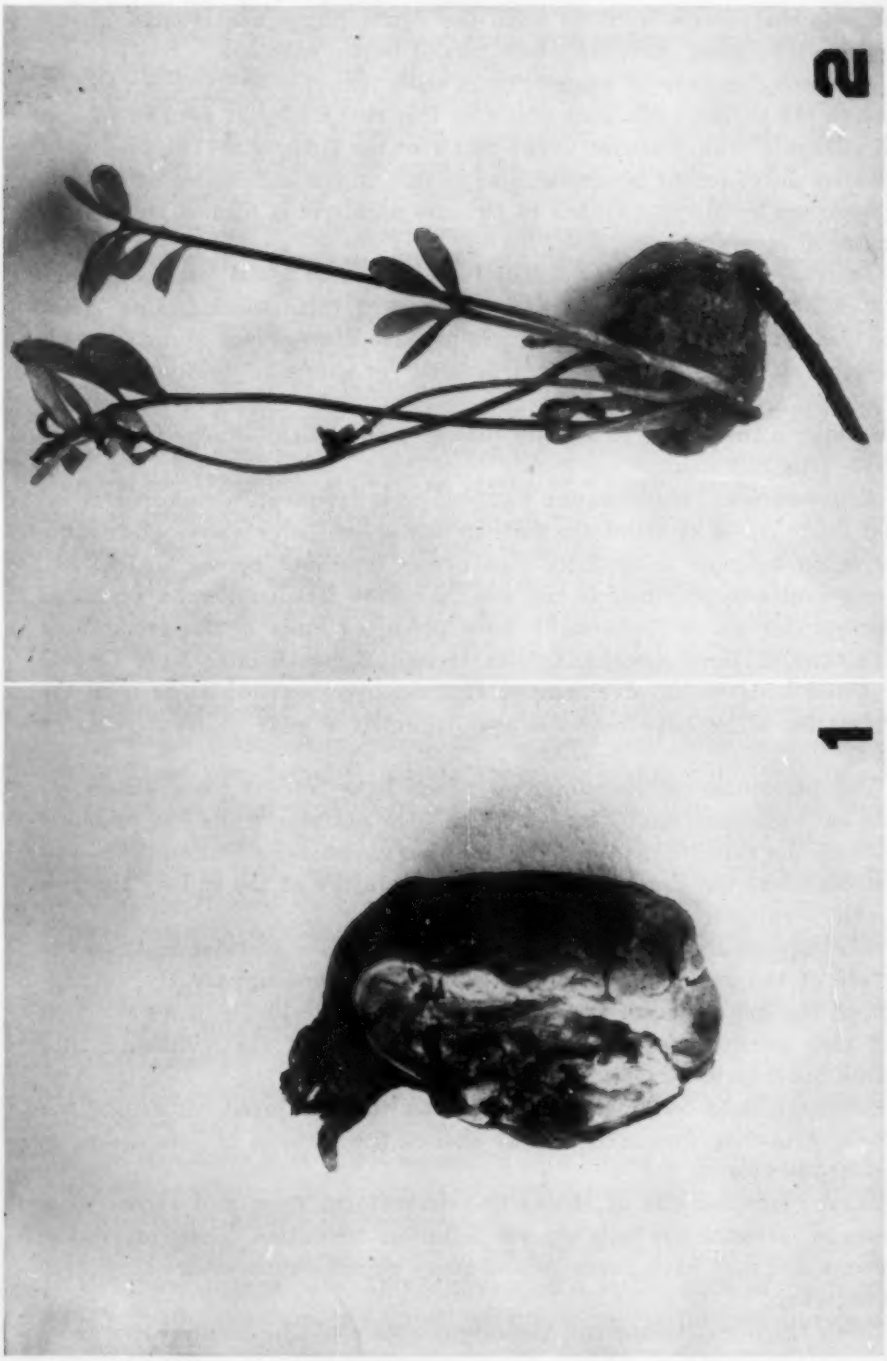

FIG. 1. Bud formed on one-half a megagametophyte of *Zamia floridana*. FIG. 2. Regenerated root and shoot on a gametophyte of *Zamia*. Note the resemblance of the miniature leaves to the leaves of normal *Zamia* seedlings.

or shoots. In one example a short axis grew out from the gametophyte and then formed a bud above and a root below, thus showing a marked resemblance to a *Zamia* seedling in miniature. In all others, roots and shoots arose separately.

Thus far, no regenerated roots have continued growth, nor elongated more than a few centimeters. None of them has produced any secondary roots. Primary roots on *Zamia* seedlings usually elongate considerably before forming secondary roots, and it may be that regenerated roots possess this characteristic of the species.

When the shoot primordia grew out they were seen to be very like seedling stems of *Zamia*, but of much smaller size. Obviously they are sporophytes which have been formed from gametophytes. Figure 2 shows the best specimen yet produced.

No regenerated plant has yet been grown beyond the stage shown in figure 2. This is probably due to the lack of root connection. Not one has lived long enough to form adventitious roots and only the one mentioned above has had a root and a shoot produced from the same bud and that one died. It is still hoped that others like this one, or with a root and a shoot produced alongside, so that a root-shoot axis may be formed, will arise and prove capable of growth to eventual maturity.

There is no possible doubt that these regenerates were formed apogamously from gametophytic tissue. Therefore, it may be assumed that they are haploid in chromosome constitution, although this is not necessarily true, and the chromosome number has not yet been determined. It is hoped that material suitable for chromosome counts will be produced in the near future.

Microscopic examination of the connection between shoots and gametophytes shows definite continuation of tissues from one structure into the other. What is most surprising is to find that the tracheids of the xylem of the stem extend deep into the gametophyte, a structure in which no tracheids have ever been found before. The bundle of tracheids ends blindly in the gametophyte. The phloem could not be traced into the gametophyte.

Discussion. This investigation carries into the Gymnospermae the principle, that, in plants showing alternation of generations, one generation can be secured (sometimes) by regeneration from the alternate generation. This principle has long been established in the Bryophyta and the Pteridophyta, but apparently it rarely has been suggested that it might apply to the Gymnospermae as well. In the Bryophyta, except in one species, regeneration only of the gametophyte from the sporophyte has been obtained; exactly the reverse of the condition of *Zamia*. In the Pteridophyta, regeneration both of gametophyte from sporophyte, and sporophyte from gametophyte has been observed, either occurring naturally or under ex-

FIG. 1. Bud formed on one-half a megagametophyte of *Zamia floridana*. FIG. 2. Regenerated root and shoot on a gametophyte of *Zamia*. Note the resemblance of the miniature leaves to the leaves of normal *Zamia* seedlings.

perimental conditions (6). Presumably, it is not to be hoped that in *Zamia*, the gametophyte can be regenerated by the sporophyte and it is rather startling that the undifferentiated gametophyte can form, by a process of regeneration, so complex a structure as the sporophyte of a seed plant. Of course, until the haploid constitution is proved for these regenerated structures, the possibility remains that some process of diploidization has taken place, and with that, the formation of all the controls which lead to development of a normal sporophyte from a fertilized egg.

Once the gametophyte has given rise to the root and shoot primordia it may not be considered surprising that these structures are able to act as sources of organization in the gametophyte itself. In the Bryophyta regeneration leads to the simpler of the generations, the gametophyte, and one would scarcely expect the gametophyte to induce any change in the sporophyte.

In fern gametophytes which have formed sporophytes apogamously tracheids have been found; a correlation first observed by Farlow (2). The formation of the tracheids may be attributed to some influence of the apogamous sporophytes which have a closer connection to the gametophyte than normal sporophytes, developed from fertilized eggs in the archegonia. Tracheids have been found in some aposporous gametophytes, and in these too, there is a direct connection with the parent sporophyte. The presence in aposporous gametophytes of other structures normally sporophytic (stomata and sporangia) may also be due to influences of the sporophytes from which they grew.

The development of tracheids in the gametophyte itself resembles the extension of vascular strands in a mass of callus with an adventitious bud on its surface. However, in the callus, there may be question as to whether the stimulus to differentiation came from the bud or from the normal vascular strands in the stem which has produced the callus. In the *Zamia* gametophyte there was no antecedent stem structure to serve as a source of the stimulus and therefore it appears that the stimulus, or organizer, whatever its nature may be, came from the bud. Or it may be that conditions which led the gametophyte to form a bud were themselves the stimulus to tracheid formation deeper in its tissues. It is truly remarkable that an undifferentiated tissue, given a considerable amount of time, freedom from decay by bacteria and other fungi, an abundant supply of food and water, and totally removed from any contact with its mother plant, should be able to develop such diverse structures as phellogen, root and stem meristems, and tracheids. The structures concerned cannot be atavistic since we are dealing with a gametophyte, and no gametophyte has ever been found which bore true roots and leaves. Whence comes the pattern of differentiation?

SUMMARY

1. Gametophytes of *Zamia floridana* were removed from ovules of various stages of development and maintained as cultures, usually on agar.

2. Little growth was obtained from stages earlier than that of fertilization.

3. Gametophytes beyond the fertilization stage increased their volume five-fold.

4. The cultured gametophytes seemed relatively indifferent to concentrations of minerals and sugar, and even to presence, or absence, of minerals, sugar, and light. A supply of water and freedom from contaminating organisms were essential.

5. Cork development was very extensive on many gametophytes.

6. Regeneration occurred, but in less than one per cent of the cultures.

7. Roots were produced but these did not continue growth, nor produce secondary roots.

8. Buds were formed which produced leaves strongly resembling miniatures of normal seedling leaves.

9. Bundles of tracheids extended from the buds into the gametophyte, where they ended blindly. Apparently the buds stimulated the transformation of gametophytic cells into tracheids.

10. This study extends to the Gymnospermae the principle that, in plants possessing an alternation of generations, one generation may be derived from the other by regeneration.

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THE BLACK ASPERGILLI IN RELATION TO CELLULOSIC SUBSTRATA[1]

W. LAWRENCE WHITE,[2] R. G. H. SIU,[3] AND ELWYN T. REESE[3]

INTRODUCTION

The most recent revision (Thom & Raper 1945) of the genus *Aspergillus* presents the following scheme of classification of the forms having enough dark coloring matter to be popularly referred to as the black group.

Aspergillus niger series
- *A. foetidus* Thom & Raper
- *A. awamori* Nak.
- *A. miyakoensis* Nak., Simo, & Watan.
- *A. niger* v. Tiegh.
- *A. niger* mut. *cinnamomeus* (Schiem.) Thom & Raper
- *A. niger* mut. *Schiemannii* (Thom) Thom & Raper
- *A. Phoenicis* (Corda) Thom & Currie
- *A. pulverulentus* (McAlp.) Thom & Currie

Aspergillus carbonarius series
- *A. atropurpureus* Zimm.
- *A. fumaricus* Wehm.
- *A. Fonsecaeus* Thom & Raper
- *A. carbonarius* (Bain.) Thom

Aspergillus luchuensis series
- *A. luchuensis* Inui
- *A. japonicus* Saito
- *A. violaceo-fuscus* Gasp.

Many hundreds of papers have been written on the nutrition and biochemical activity of these forms, which commonly are designated loosely as "*Aspergillus niger.*" However, no detailed consideration has been given to the question of their ability to hydrolyze cellulose and utilize the products as carbon sources, and no mention at all has been made of the behavior of the individual species in this connection. Those papers which have touched upon the subject have come mostly from the textile industry, and the references have been incidental to the main theme. This, together with the non-exacting use of the name "*A. niger*" to cover the whole range of morphological and physological forms found in the black group has resulted in an accumulation of brief, widely scattered, inconclusive, and con-

[1] Presented in preliminary form at the A.A.A.S. Meeting in Chicago, December 1947; abstract in Am. Journ. Bot. 34: 596 (D 1947).

[2] At U. S. Army Quartermaster Corps Biological Laboratories during the progress of this work; present address Biological Laboratories, Harvard University.

[3] Army Quartermaster Corps Biological Laboratories.

The authors are indebted to Miss Mary H. Downing of the Q.M. Biol. Lab. for carrying out much of the experimental work; to Mr. William Bridge Cooke formerly of the same laboratory and now at Washington State College for a preliminary sorting out of cultures; to Dr. Kenneth B. Raper of the Northern Regional Research Laboratory for supplying authentically identified cultures; to Drs. H. D. Barker and Paul B. Marsh of the Division of Cotton and other Fiber Crops and Diseases, U.S.D.A. for reading the manuscript; and to the Photographic Department of the Philadelphia Quartermaster Depot for taking the photographs.

tradictory statements concerning the relationship of "*A. niger*" to cellulosic substrata.

During the period of 1940 to 1945 there was widespread use of strains of the *A. niger* group by both government and commercial laboratories in this country, and to a lesser extent those of the British Empire, as a test organism for the assessment of mold-proofness in a great variety of manufactured products, especially those intended for military use in the tropics. For testing cotton fabrics they were used alone or supplemental to such universally employed and strongly cellulolytic species of fungi as *Chaetomium globusum* Kunze and *Myrothecium verrucaria* (Alb. & Schw.) Ditm. ex Fr. (= *Metarrhizium glutinosum* Pope). For the testing of plastics, leather, paper, paint, glue, etc., and the many combinations of such component materials that go into the makeup of completed items like coated fabrics, radio sets, electrical apparatus, optical equipment, and packaging materials they were used alone or perhaps more often in combination with other molds.

There was a general feeling on the part of those charged with the responsibilities of procurement testing, and of those engaged in the development of test methods, that "*A. niger*" was one of the organisms that should be employed. The reasons for its selection were the frequency with which such forms were isolated from a wide range of decomposing materials and their presumably high relative tolerance to fungus-inhibiting chemicals. The fact of strain differences was well known, but there was no data at hand to indicate a choice of one strain as superior to another for the particular type of material to be tested. This was a subject for debate and discussion at many conferences, and pertinent notes have appeared in numerous mimeographed military and commercial reports. But because of the limited investigations that could be carried out during wartime on the nature and activities of the organisms themselves, there are still almost no data on the relative adaptability of strains to testing procedures.

Certain groups of workers selected the culture designated as TC *215–4247* for the sake of standardization, and others followed suit. This strain was the basis of a well known long series of nutritional studies by Dr. R. A. Steinberg begun in 1918 and continued to the present time. The selection was not made on the basis of any demonstrated superiority of this strain over others. Rather, the reasoning was to the effect that in the absence of any information on strain adaptation for the specific purpose, it was desirable to choose a strain having a long pure-culture history and whose cultural stability and nutritive requirements were well established. The strain, TG *215–4247*, represents *Aspergillus niger* v. Tiegh. *sensu strictu*.

For the most part, those not employing TC *215–4247* used Australian

Mycological Panel serial number *26*. This was isolated at Sydney about 1943 from a wireless set stored there in a test chamber and was recommended by the Australian workers for inclusion in a "mold mixture for the testing of electrical equipment, paper, etc." Thus far it appears not to have been identified any more precisely than as a member of the *A. niger* group.

A fundamental consideration in the wartime discussions and reports (mostly unpublished) concerning the use of "*A. niger*" in testing procedures had to do with the question of whether or not it was capable of degrading cellulose. In the practical selection of test organisms for leather products, paint, and the like, this question is, of course, irrelevant. But with cellulose in some form being an ingredient of so many items, the question would appear to be a basic one in the selection of test strains either for cotton fabrics or for broad general use.

The purpose of this paper is to resolve the question of cellulose decomposition by the black *Aspergilli;* to determine whether positiveness and negativeness of cellulolytic activity, if both are found to exist, correlate with the current taxonomy of the group; to present a summary of studies on their behavior toward cellulosic fabrics and similar materials in the field; and to offer suggestions which may be of eventual value in the selection of strains for use in the testing of mold-proofness of cotton fabrics and other cellulosic materials.

LITERATURE REVIEW

The pertinent literature may be broken down to three convenient and more or less distinct categories: (1) decomposition of cellulose, (2) field and storage damage to fabrics, and (3) use in assessment testing.

Decomposition of Cellulose. The controversy concerning cellulolytic action of "*A. niger*" is not of recent origin. Van Iterson (1903) noted that the "quantity or nature" of the cellulolytic enzyme secreted by the various species of molds varied considerably as evidenced by great differences in destructive power. As a result of growth on paper discs and dissolution of cellulose in paper pulp cultures, he grouped twenty species as powerful, moderately strong, weak and negative. Among the weak was "*A. niger.*" Scales (1915) reported it capable of utilizing the reprecipitated cellulose of filter paper, as indicated by a zone of clearing. Gerry (1923), in an investigation of the effects of hyphomycetous molds on wood designated for exacting purposes in World War I, found that in long pure-culture tests on wood blocks the hyphae grew in the cell cavities and passed from cell to cell through natural openings, not penetrating the lignified cellulose of the cell walls. There was little or no damage beyond the production of a surface discoloration. The implication was that the organism did not break down

lignified cellulose. Paine (1927), working in Iowa, tested an isolate from local soil by attempting to grow it on cotton batting, absorbent cotton, and filter paper when these were partially immersed in a mineral salts solution. The results were negative. About the same time Thaysen and Bunker (1927), briefly reviewing the earlier literature, confined themselves to the conservative conclusion that "*A niger*" was "frequently encountered wherever cellulose decays." Galloway (1930), in a general treatment of the fungi that were found troublesome to the British cotton industry, tested one strain for cellulolytic activity, and rated it as "moderate" on the basis of the amount of visible growth produced on filter paper on a mineral salts agar. This was considered an indication, though not an infallible criterion of the ability of the organism to tender cloth by decomposing the cellulose. In a pure culture test on cotton yarn, "*A. niger*" was stated to have brought about a decline in tensile strength, while *A. Sydowi* and *Rhizopus nigricans* gave negative results. Norman (1930) worked with several organisms, including "*A niger,*" in relation to the decomposition of straw and referred to the lot categorically as cellulose destroyers, but seemingly did not prove actual cellulolytic action for any of them. Klemme et al. (1945) tested the activity of a considerable number of isolates of various Fungi Imperfecti on cotton duck in the presence of a mineral salts solution and recorded results in breaking strength ranging "from 97 per cent for one strain of *Metarrhizium glutinosum* to no loss for *Aspergillus niger.*" The strain of *A. niger* used was the TC *215–4247* previously discussed. Marsh et al. (1945) made reference to copper tolerance of *A. niger,* presumably based largely on tests of TC *215–4247,* and noted that several isolates which they had used in experiments had failed to decompose cellulose.

The foregoing records add up to four positive, four negative, and two implying positivity for cellulolytic activity.

Early in the program of our own laboratory a system was set up for the routine testing for cellulolytic activity of molds which were being isolated from fabrics, etc. exposed in the tropics. Thirty-one strains of black *Aspergilli* were included in these tests (White, Darby et al. 1948). A decline in the strength of strips of grey cotton duck or of a more highly purified bleached sheeting in the presence of the mineral salts medium[4] recommended by Greathouse, Klemme, and Barker (1942) was taken as a measure of cellulolytic activity. Some strains were tested on both kinds of cloth and by several minor variations in the basic method, using, however, the same mineral salts formula throughout. All strains except two, JQMD *745* and PQMD *23b,* gave clearly negative results, and these two strains, under

[4] Composition in grams per liter: K_2HPO_4, 1.3940; $MgSO_4 \cdot 7H_2O$, 0.7395; NH_4NO_3, 1.0006; $CaCo_3$, 0.005; NaCl, 0.005; $Fe_2(SO_4)_3 \cdot 7H_2O$, 0.001; $MnSO_4$, 0.001; initial pH 6.8.

the conditions of the tests, proved to be active only on the duck. After the discovery of their cellulolytic activity they were examined more thoroughly and found to be members of the *A. luchuensis* series. They were recorded in the previous paper as *A. luchuensis* Inui. Another strain (PQMD *124g*) recorded as *A. japonicus* failed to break down bleached cotton sheeting and was not tested on grey duck. The remaining 28 isolates, including Australia *26* to which reference was made on a previous page, were clearly all inactive. They were identified only as members of the *A. niger* group as that group was treated by Thom and Raper (1945); none of them were members of the *A. luchuensis* series. In another experiment carried out in this laboratory in a study of methods (Reese 1947), negative results were obtained when JQMD *745* (under the name *A. niger*) was incubated in a ground filter paper–mineral salts solution in shaker flasks. The method proved highly conducive to cellulolytic action of known cellulose destroyers which were run in parallel series. Siu (1947), on the basis of unpublished work to be reported in detail in the present paper, made brief reference to yeast extract as a requirement for cellulolytic activity of culture JQMD *745* (also referring to it as *A. niger*).

Field and Storage Damage to Fabrics. Dorée (1923) reported isolation of "*A. niger*" from hemp in the Philippines, the material showing a large percentage of brittle and discolored fibers. In inoculation tests it proved to be damaging to the poorer grades of hemp but scarcely so to Grade A material. The explanation was that its nourishment was mainly from the starch content of the pulp remaining in the low grade material. Armstead and Harland (1923), found the organism mainly responsible for mold in loin cloths manufactured in England and transported to India to be "an *Aspergillus* of the *niger* group." The illustrations make it clear that they were working with a strain or strains other than of the *luchuensis* series. No reference was made to any actual deteriorative action against the cellulose, but emphasis is laid on its ability to cause objectionable growth and staining and to attack unsized weft threads even though the warp sizing contained a "full quota of antiseptic." Bright, Morris, and Summers (1924), in a generalized account of mold problems in the British cotton industry, stressed the importance of *Penicillium*, *Mucor*, and *Aspergillus*, especially "*A. niger*," but indicated that while most common they were less apt to tender. It was stated, however, that as of that date there was little or nothing known of ability of such forms to tender, i.e., actually decompose, the cellulose of the fibers. Reiners (1924) stated that at low moisture content the molds most apt to develop were species of *Aspergillus*, of which "*A. niger*," was one of the first to appear. He noted that molds were least troublesome in unsized fabrics and emphasized control through use of antiseptics in sizing. Bright (1926) in a study of staining and swelling techniques to

be used as criteria of types of damage to cotton fibers, attempted to produce fungal damage experimentally by inoculating with spores sterilized fibers moistened with distilled water. "*A. niger*" was one of two fungi employed. Fibers inoculated with the organism were said to be degraded on the basis of the Congo red test, while they doubtfully passed the swelling test as undamaged. In contrast, the second fungus, not named but said to be a strong cellulose destroyer, did obvious damage with either test as a criterion. The reader is left somewhat puzzled as to whether the *Aspergillus* did or did not damage the fibers. Galloway (1930) noted that "*A. niger*" was one of the most commonly encountered molds in the whole make-up process from the boll in the field to shipping of the finished fabric where it grew in the starchy sizing material, vigorously producing acids and causing objectionable staining. Galloway (1931) used "*A. niger*" as one of several test organisms with which he was able to experimentally produce "diamond spot" in cotton cloth.

Use in Assessment Testing. Black *Aspergilli* have been employed in the assessment testing of fabrics by a number of methods with and without an accessory carbon source. No attempt will be made to evaluate these methods, but some are mentioned as a matter of interest. Marsh et al. (1944) made successful use of strain TC *215–4247* for the assessment of fungus resistance of cotton fabrics by a method employing a small amount of accessory carbon in the mineral solution. He noted that the organism was "not a true cellulose destroyer" and that it was highly copper-tolerant. Spores planted on strips of fabric treated with copper tallate or copper oleate produced bleached zones in which the copper had been solubilized by the fungus. In the same year, Bertolet (1944) stressed the need for testing fabrics for resistance "not only to cellulose decomposing organisms but also to superficial organisms such as *Aspergillus niger*. . . ." A paper prepared by an AATCC Subcommittee on Mildew Proofing (1945) indicated methods for the use of TC *215–4247* in cotton fabric assessment testing by the addition of a small amount of other carbon sources to the mineral salts medium so that the organism is not dependent upon the cellulose of the fabric for its carbon nutrition. Bayley and Weatherburn (1945), referring to strain TC *215–4247* as a surface grower, found it considerably more tolerant to copper naphthenate than the well known cellulose destroyers *Chaetomium globosum*, USDA *1042.4*, or *Myrothecium verrucaria* (= *Metarrhizium glutinosum*), USDA *1334.2* on the basis of visual growth on copper-naphthenate-impregnated bleached and purified cotton sheeting incubated on a mineral salts agar. The *A. niger* was said to have produced a heavy growth, equally good at all concentrations of copper tried, i.e., 0.005 to 0.8 per cent metallic copper on the weight of the fabric, whereas the other organisms were nearly or completely inhibited at the higher concentrations. The source

of carbon necessary for the reported heavy growth must stand as something of mystery. Scribner & Abrams (1946) found "*A. niger*" to appear to some extent on kraft paper and its associated cementing and strengthening materials exposed in a "tropical" test chamber in Washington, D. C., and used strain TC *215–4247* for pure culture tests of such materials by growing the organism on a mineral salts agar containing 30 grams of sucrose and incubating the paper or other material on the already formed mycelial mat.

Incidental mention may be made at this point of a few of the more recent papers in which reference is made to "*A. niger*" for the testing of mold-proofness of materials of composition primarily other than natural cellulose (Appling & McCoy 1945). Olson & Macy (1945) employed a strain in experiments in the control of surface growth on butter wrapped in sodium- and calcium-propionate-impregnated parchment; Titus (1945) made reference to its use for testing by the General Electric Company of plastics and cellulosic materials of electric apparatus; Brown (1946) used it for plastics; Kanagy et al. (1946) noted it as one of the principal forms developing on leather under various test conditions; and Lavers & Illman (1946) used it in a mold mixture for testing packaging material including those of cellulose and its derivatives.

In so far as can be determined, none of the strains employed in the published accounts of the assessment testing of materials, of whatever nature, have been members of the *A. luchuensis* series. Probably all of them represented *A. niger* in the narrow sense.

EXPERIMENTS

Experiment 1. Activity of Strains of the Aspergillus luchuensis Series on Grey Cotton Duck (figs. 1–3). Before the series of assays reported by White, Darby et al. (1948), culture JQMD *745* had been found capable of decomposing cellulose when tested on grey cotton duck by Dr. G. W. Martin at the Biological Laboratories of the Jeffersonville (Indiana) Quartermaster Depot, where the strain had been isolated. Following confirmation of this in our own laboratory, together with similar results with our own PQMD *23b*, it was thought desirable to determine whether or not cellulolytic ability was a characteristic of certain series or species of the black *Aspergilli* as this group had been treated taxonomically by Thom and Raper.

Of the several thousand cultures in our collection (excluding a set from Panama which has not yet been examined critically by the present writers), mostly isolated from military materials from the warmer parts of the world, a total of approximately eighty numbers had been carried in stock as members of the *A. niger* group. A thorough examination of these revealed ten as belonging to the *A. luchuensis* series and having morphological characters extremely close to those of JQMD *745* and PQMD *23b*. When grown

on potato dextrose agar in parallel series they exhibit minor differences in their gross aspect, as well as in microscopic characters, but are remarkably uniform in color of the fruiting surface, being almost precisely "bone brown" of Ridgway (1912). Such factors as age, temperature, and variations in substrata have no perceptible effect on color; and of the isolates of the *A. niger* group from military equipment which have thus far accumulated in our culture collection, the cellulolytic strains may easily be segregated from the non-cellulolytic ones by the color exhibited by the stock cultures, the cellulolytic ones being "bone brown," the non-cellulolytic strains in darker shades—more nearly black.

Seven of the "bone brown" cultures were selected for the following cellulolytic tests. In addition to these, culture TC *215–4247* was included because of its wide use in assessment and procurement testing. Three additional cultures identified only as members of the *A. niger* group (but not members of the *A. luchuensis* series) were selected at random for comparison. *Chaetomium globosum*, USDA *1042.4* was included for comparison because it has come to be recognized as a standard test strain and its strong cellulolytic activity is familiar to all who are interested in the microbiological decomposition of cellulose.

Test cloth was prepared by cutting twelve-ounce grey cotton duck into warp-wise strips 1¼ inches wide, further raveling to exactly 1 inch, then clipping to six-inch lengths. Such strips were then inserted 1 each in 20 × 200 mm. Pyrex test tubes of 75 ml. capacity each containing 25 ml. of Greathouse's formula A (see footnote 5) mineral salts solution. The tubes were then plugged with cotton and autoclaved at 15 lbs. pressure for 20 minutes. After cooling, 2 ml. of a spore suspension was distributed evenly over the upper (unsubmerged) half of the strip. The inoculum was prepared by growing the organisms on potato dextrose agar slants (2% dextrose) in 17 × 150 ml. test tubes under room conditions for 9 days (30 days for *Chaetomium globosum*). Approximately 20 ml. sterile distilled water was added to each tube, the spores loosened and brought into suspension by teasing with a pipette and made up to a volume of 32 ml. in a flask. This gave a fairly strong suspension. It has been shown by Greathouse et al. (1942) that within broad limits the concentration of spores makes but little difference except perhaps during the very early period of incubation. The tubes were then incubated in a room under conditions approximating 85° F and 80% relative humidity. At harvest the strips were removed, washed in 95% ethanol, then tap water, dried under room conditions, subjected to standard conditioning of 24 hours at 75° F and 65% relative humidity, and broken on the motor driven Scott tester with a three inch space between the jaws.

The results are presented in figures 1–3. The growth patterns and rela-

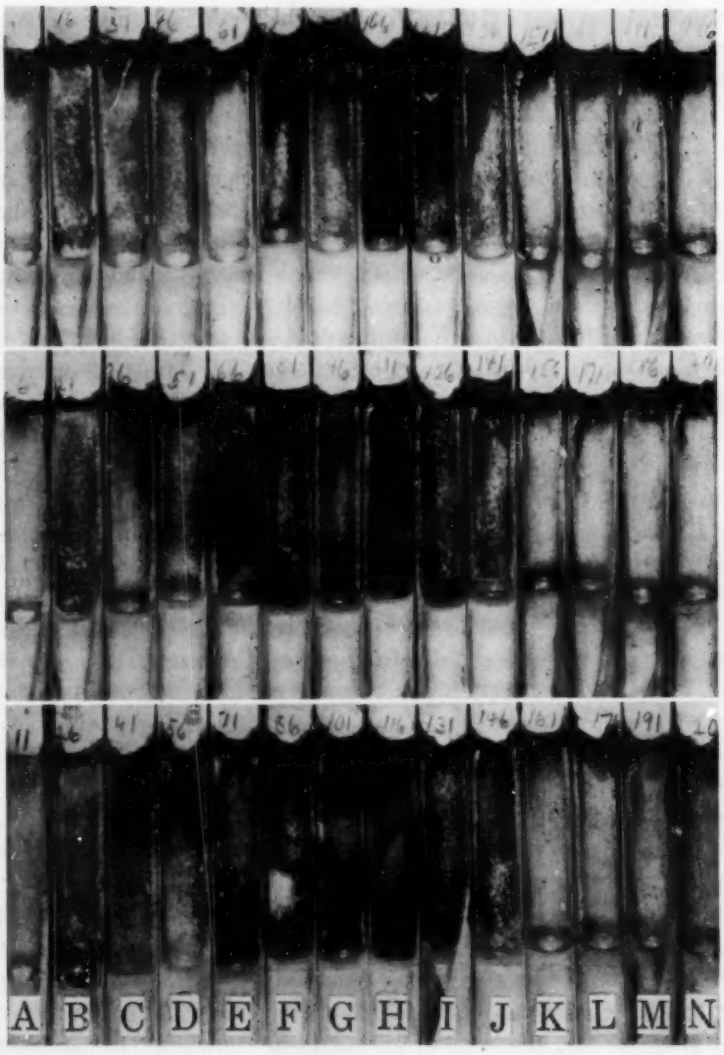

Figure 1

Growth of black *Aspergilli* on strips of grey cotton duck in test tubes. Each tube is representative of 5 replicates. Horizontal rows: top, 7 day harvest; middle, 14 day harvest; lower, 21 day harvest. Vertical rows: A, uninoculated controls; B, *Chaetomium globosum*, USDA *1042.2;* C–J, members of the *A. luchuensis* series: C, PQMD *21e;* D, PQMD, *23b;* E, PQMD *70c;* F, PQMD *102d;* G, PQMD *155e;* H, JQMD *190;* I, JQMD *228;* J, JQMD *745;* K–N, *A. niger* group other than *A. luchuensis* series: K, TC *215–4247, A niger sensu strictu;* L, PQMD *38b;* M, PQMD *154a;* N, PQMD *198b.* × slightly less than ½.

tive amounts of growth are indicated in the plates. The decline in tensile strength is indicated in figure 3 where the bars represent pounds strength retained on the basis of an average of 5 replicates.

As indicated in figure 3 all of the eight strains of the *A. luchuensis* series proved to be cellulolytic. The so-called official strain, TC *215–4247*, i.e., *A. niger* in the narrow sense, and three strains identified only as being in the *A. niger* group exhibited no action. All strains of the *A. luchuensis* series were weak in comparison with the powerful cellulose destroyer, *Chaetomium*

FIG. 2. Black *Aspergilli* on strips of grey cotton duck in test tubes. From same experiment as shown in figure 1 at end of 14-day incubation period. Showing uniformity of growth obtained for replicates and contrast between PQMD *102d*, representing the *A. luchuensis* series and TC *215–4247* representing *A. niger sensu strictu*. A. control; B, PQMD, *102d*, fruiting so heavily as to almost obscure the fabric; C, TC *215–4247*, showing little evidence of growth except for the presence of a few heads at the extreme tops of the strips. × approx. ⅔.

globosum. The growth (fig. 1) of the various *luchuensis* strains, consisting visually of fruiting structures with little evidence of vegetative mycelium, varied somewhat in pattern among the various strains, but was in general heavy, evenly distributed, and reached approximately its maximum development in seven days or a little more. In strains other than of the *A. luchuensis* series growth was extremely meagre, being evidenced only by a few scattered fruit bodies mostly at the upper end of the cloth strip. In general the amount of visual growth was roughly correlated with the effect of the various strains on the tensile strength of the fabric. No pigmentation was produced by any of the strains. The point of greatest cellulolytic activ-

ity on the strips of fabric, as indicated by the points of breakage of the strips on the Scott tester, was very slightly above the water line for *Chaetomium globosum* and the stronger strains of the *luchuensis* series, i.e., *102d* to JQMD *745;* for the weaker strains the breaks occurred somewhat at random above the water line; and for the controls and the remaining non-active strains of the *niger* group they were completely at random.

Experiment 2. Activity of Strains of Miscellaneous Species of Black Aspergilli from Northern Regional Research Laboratory on Grey Cotton Duck (figs. 4–5). Up to this point, including this paper and the preceding one (White, Darby, et al.), a total of 39 strains of the black group were tested. Eight were identified as members of the *A. luchuensis* series. All proved to be cellulolytic. Thirty-one were determined to be non-members of the *luchuensis* series. All of these were non-cellulolytic. Of the 31 it may be assumed that the majority were *A. niger* sensu stricto. It is possible that other species of the black group were represented.

However, in order to be sure that the assays covered a wide range of forms, isolates of several additional known species were obtained from Dr. Raper for further tests.

The entire procedure in this experiment was the same as for the preceding one, except that the previously employed 7-, 14-, and 21-day incubation priods are changed to 14, 21 and 28 days. The USDA strain of *Chaetomium globosum* was again included for comparison and PQMD *102d* was repeated for the same reason. The results are presented in figures 4 and 5.

The results presented in figures 4 and 5 indicate cellulolytic activity for only three of the NRRL cultures, viz: *A. japonicus,* NRRL *358* and NRRL *359* and, for *A. niger* mut. *Schiemanni,* NRRL *361.* NRRL *359* was substantially equivalent to the strongest of the PQMD strains of the *A. luchuensis* series in the decline caused in tensile strength and in amount of growth produced, while *358* was weak in both respects. All members of the remaining 8 taxonomic categories failed to affect the strength of the fabric or to make appreciable growth, and it is noteworthy that this was true of the numbers determined as *A. luchuensis* and *A. violaceo-fuscus.*

The mutant *Schiemanni* produced an amount of growth and a decline in tensile strength of the fabric equivalent to the stronger strains of the *A. luchuensis* series. This is out of line and poses an interesting question as to the origin of the so-termed "mutant." It is a pale ochraceous form having little superficial resemblance to the general run of the *A. niger* group. If it mutated from a member of the *A. niger* series it must have, in addition to the loss of spore color and markings, acquired the property of being able to split cellulose; if it arose from members of the *A. luchuensis* series it acquired primary sterigmata.

Also worthy of comment is the fact that the NRRL cultures of *A. japoni-*

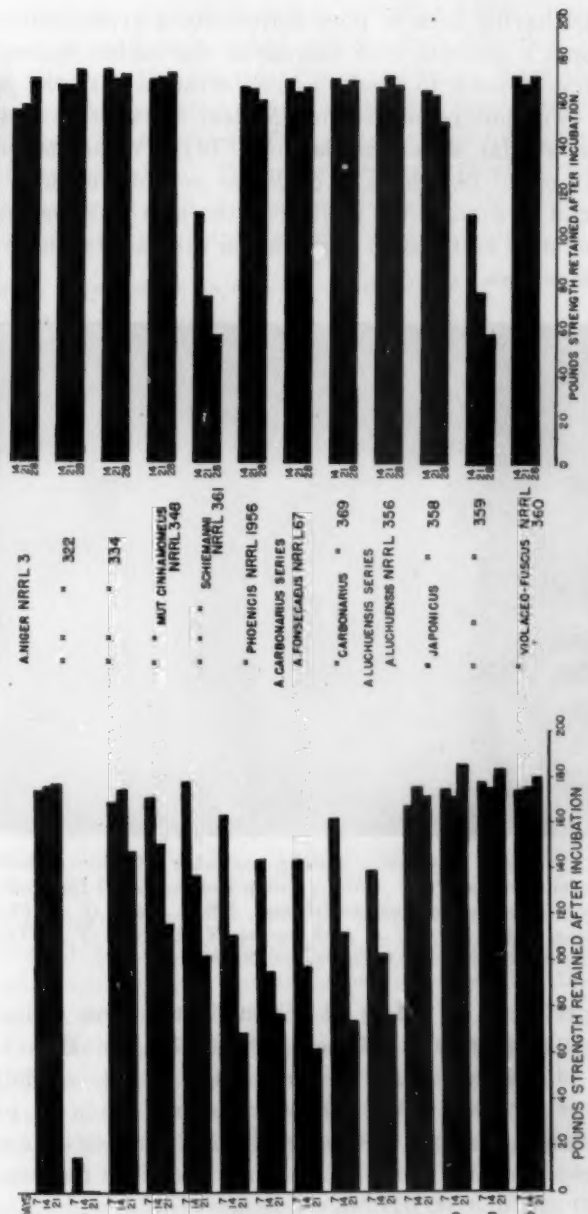
ORGANISM
DAYS
UNINOCULATED CONTROL
C. GLOBOSUM USDA 1042.4 CONTROL
A. LUCH. SER. PQMD 238
" " " 236
" " " 705
" " " 1024
" " " 1856
" " " JQMD 190
" " " 228
" " " 745
" NIGER TC 215-4247
" " GROUP PQMD 386
" " " 1546
" " " 1986
A. LUCH. SERIES PQMD 1024 CONTROL
A. NIGER SERIES
A. POETIDUS NRRL 341
A. NIGER NRRL 3
" " " 322
" " " 334
" " MUT CINNAMOMEUS NRRL 348
" " " SCHIEMANN NRRL 361
" PHOENICIS NRRL 1956
A. CARBONARIUS SERIES
A. FONSECAEUS NRRL 67
" CARBONARIUS " 369
A. LUCHUENSIS SERIES
A. LUCHUENSIS NRRL 356
" JAPONICUS " 358
" " " 359
" VIOLACEO-FUSCUS NRRL 360
POUNDS STRENGTH RETAINED AFTER INCUBATION

FIG. 3 (left). Cellulolytic activity of members of the *Aspergillus luchuensis* series on grey cotton duck. FIG. 5 (right) Cellulolytic activity of NRRL cultures, representing miscellaneous species of the *A. niger* group, on grey cotton duck.

cus after having been in pure culture for a great many years, presumably on Czapek's medium with sucrose as the carbon source, conformed upon their first transfer to a cellulosic substratum with the pattern of behavior of our own more recent isolates. Mutant *Schiemanni* had been in pure culture on similar sugar media since 1912. What its original cellulolytic strength might have been, is of course not known. Such instances do, however, tend to counter the feeling on the part of some workers that maintenance of stock cultures on sugar media will cause them to loose their cellulolytic properties.

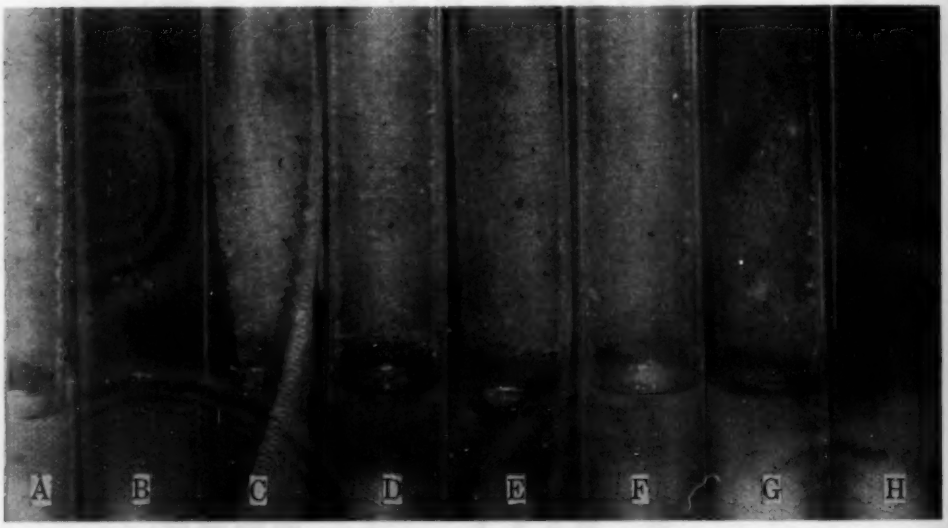

FIG. 4. Strips of grey cotton duck in test tubes after having been inoculated with strains of miscellaneous species of the *A. niger* group and incubated for 28 days at 85° C. A, uninoculated control; B, *A. niger* mut. *Schiemanni*, NRRL, *361;* C, *A. Phoenicis*, NRRL *1956;* D, *A. Fonsecaeus*, NRRL *67;* E, *A. carbonarius*, NRRL *369;* F, *A. luchuensis*, NRRL *356;* G, *A. japonicus*, NRRL*358;* H, *A. japonicus*, NRRL *359.* × ⅔.

Experiment 3. Effect of Yeast Extract on Cellulolytic Action of Aspergillus luchuensis Series, JQMD *745*, on Bleached Cotton Duck. (table 1). Since, under the conditions of the cellulolytic tests (White, Darby et al.) to which brief reference was made on previous pages, the strains which were of other than the *A. luchuensis* series were inactive on both grey duck and bleached sheeting, and since the two *luchuensis* strains (PQMD *23b*, and JQMD *745*) were active on grey duck but not on bleached sheeting, the question arose as to whether the differential ability of these forms to attack grey duck and not bleached sheeting was due to a chemical alteration of the latter fabric by the sodium hydroxide and sodium hypochlorite bleach or to a removal of necessary growth factors.

The following experiment was conducted to investigate this point. Strips of hypochlorite-bleached and unbleached cotton duck ravelled to 3 × 1 inches, were placed 1 each in 15 × 150 mm. Pyrex test tubes. Each tube contained 8 ml. of the medium indicated below,[5] which was considerably modified from Fries' medium no. 3 (Fries 1938), with or without the addition of 0.1 per cent Difco yeast extract. The procedure from there on was similar to that of experiments 1 and 2. The decline in tensile strength was taken as an index of mycological action, as presented in table 1.

TABLE 1. *Effect of yeast extract on activity of JQMD 745 of the A. luchuensis series on cotton duck.*

Cloth	Yeast extract in medium	No. of replications	Tensile strength in lbs.			% loss in tensile strength	
			0 days	9 days	15 days	9 days	15 days
Grey duck	Absent	16	156	101	79	35	49
	Present	16	158	96	71	39	55
Bleached duck	Absent	16	122	106	102	13	16
	Present	16	124	82	66	34	47

The data in table 1 clearly show a stimulating action of yeast extract on the cellulolytic activity of JQMD *745*. When grey duck was used the increase in cellulolytic activity was slight. However, while the organism was able to degrade bleached duck only slightly in the absence of yeast extract, the addition of yeast extract increased the rate of degradation to that of grey duck. This indicates that the failure of JQMD *745* to degrade bleached cotton fabric is not due to a chemical modification of the cellulosic substrate into a resistant derivative, but to the removal of necessary supplementary "nutrilites" found in grey duck.

Pertinent to the above, it may be pointed out that many workers have established that certain or perhaps most strains of the *A. niger* group do not require vitamins and similar organic growth factors for normal development. This apparently is true of TC *215–4247*.

Experiment 4. Growth on Filter Paper of the Strains used in Experiment 1 (fig. 6). Discs of Whatman's No. 2 filter paper 7 cm. in diameter (previously sterilized in a hot-air oven at 170° C for 2 hours) were placed 1 each in standard 9 cm. petri dishes each containing 35 cc. of Greathouse formula A mineral salts (as used in exp. 2 & 3) in 2% Bacto agar and inoculated with the same series of organisms as that used in experiment 1.

[5] Composition per liter: NH_4NO_3, 3.0 gm.; KH_2PO_4, 1.0 gm.; $MgSO_4 \cdot 7H_2O$, 0.5 gm.; NaCl, 0.1 gm.; $CaCl_2$, 0.1 gm.; $CuSO_4 \cdot H_2O$, 0.25 mgm.; $Fe_2(SO_4)_3 \cdot H_2O$, 0.544 mgm.; $MnSO_4$, 0.055 mgm.; $ZnSO_4 \cdot 7H_2O$, 4.97 mgm.; $(NH_4)_2[P(MO_2O_{10})_4]$, 0.02 mgm.; H_3BO_3, 0.057 mgm.

For inoculum each organism was grown for about 24 hours on potato dextrose agar (5 gm. dextrose per l.) and a bit of the agar 1–2 mm. square containing the non-sporulating mycelium was transferred to the center of each filter paper disc. The dishes were then spread out on a laboratory table under room conditions and allowed to incubate for 15 days.

While the *Chaetomium globosum*, carried along for comparison, grew rapidly (fig. 6A), no growth over and above that to be expected as a result of nourishment in the inoculum was made by any of the strains of the black

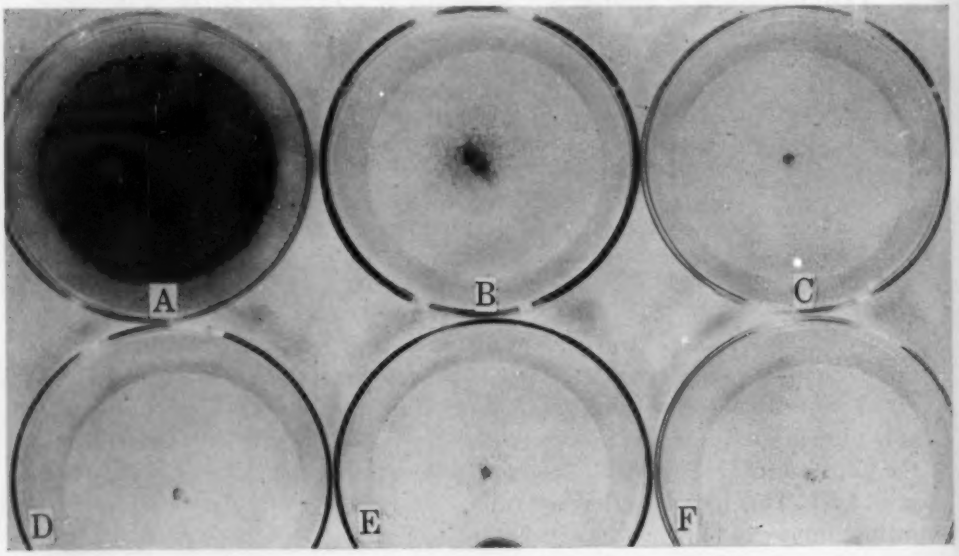

FIG. 6. Growth of black *Aspergilli* on filter paper discs on mineral salts agar following inoculation at a central point, followed by 15 days incubation under room conditions; A, *Chaetomium globosum*, USDA *1042.4* for comparison; B, C, D, *Aspergillus luchuensis* series PQMD *102d*, JQMD *228*, and JQMD *745* respectively; E, *A. niger*, TC *215–4247*; F, an unidentified member of the *A. niger* group (not in *A. luchuensis* series), PQMD *38b*. × slightly more than ½.

Aspergilli (fig. 6 B-F). In all cases it was characterized by sparse, incipient and aborted fruit bodies scattered within an area of a few mm. from the point of inoculation. Individual differences were small and scarcely worthy of record. The best development was reached by PQMD *102d* which formed small conidiophores over an area of a 15 mm. radius from the center (fig. 6B). In no case was there any pigmentation, superficially visible mycelium or other evidence of activity. The relative growth of the *Chaetomium* plus 5 strains of the *Aspergilli* tested (listed in exp. 1), including strains of the *A. luchuensis* series as well as of other species, were incapable of utilizing filter paper as a carbon source.

Experiment 5. Activity on Filter Paper and Bleached Cotton Sheeting on Mineral Salts Agar with and without Yeast Extract (fig. 7, table 2). On the assumption that in experiment 4 the failure of the various

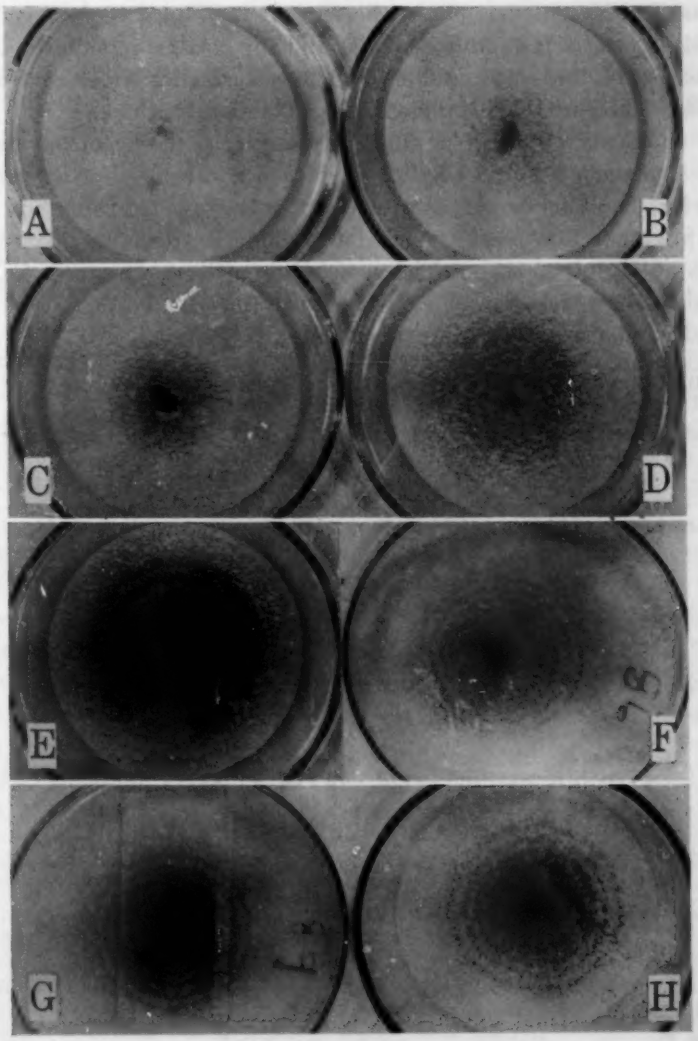

FIG. 7. Growth of two species of black *Aspergilli* on filter paper and bleached cotton sheeting on mineral salts agar, with and without yeast extract, following inoculation at a central point with a small bit of agar with non-sporulating mycelium, followed by 15 days incubation under room conditions; A–E, *A. luchuensis* series, PQMD *102d;* A, no yeast extract; B, 0.01 yeast extract; C, 0.001 yeast extract; D, 0.01 yeast extract; E, 0.1 yeast extract; F–H, *A. niger sensu strictu,* TC *215–4247,* with 0.1 yeast extract; F, without cellulose; G, on bleached sheeting; H, on filter paper. × ½.

strains of the *A. luchuensis* series to break down filter paper was due to a nutritional deficiency, rather than to any peculiarity of the cellulose, a similar set of tests was made, in which yeast extract was added to the medium. As representative of the *A. luchuensis* series, the numbers PQMD *102d* and JQMD *190* were chosen because of their previously demonstrated relatively strong action on grey duck, and for strains outside the *A. luchuensis* series, TC *215–4247* and PQMD *38b* were chosen for comparison or contrast because of their complete lack of action on duck.

The cellulosic materials employed were filter paper from the same lot as that of experiment 4, and also 3.3 oz. bleached cotton sheeting cut to 3×1 inch strips. The filter paper, as previously, was subjected to hot-air sterilization, while the cloth was subjected to standard steam sterilization of 20 minutes at 15 lbs. pressure. The same agar medium was used except that percentages of yeast extract were added as indicated in table 2. Inoculation and incubation was as in experiment 4.

TABLE 2. *Growth on filter paper and bleached cotton sheeting on mineral salts agar with and without yeast extract after 15 days incubation.*

Organism	Yeast extract	Control	Filter paper	Cotton sheeting
A. luchuensis series, PQMD 102d	0.0	+	++	++
	0.0001	++	+++	−++
	0.001	+++	++++	+++
	0.01	+++	+++++	+++
	0.1	++++	++++++	++++
A. luchuensis series, JQMD *190*	0.0	0	+	+
	0.0001	+	++	+
	0.001	++	++	++
	0.01	++	+++	++
	0.1	+++	++++	+++
A. niger, TC *215–4247*	0.0	+	+++	++
	0.0001	++	+++	++
	0.001	+++	+++	+++
	0.01	+++	++++	++++
	0.1	++++	+++++	+++++
A. niger group, PQMD *38b*	0.0	+	+++	+++
	0.0001	++	+++	+++
	0.001	+++	+++	+++
	0.01	+++	++++	++++
	0.1	++++	+++++	+++++

Estimates of visual growth are indicated by + signs in table 2. These signs are used to indicate relative growth in this experiment alone and have no relation to usage elsewhere. The values of the signs may be had by comparison with the corresponding categories in figure 7.

The following points may be made from the table: (1) In marked contrast to the results of experiment 1 where grey duck was used as cellulose,

the two strains of the *A. luchuensis* series (PQMD *102d* & JQMD *190*) received no more stimulation from filter paper than did those (TC *215–4247* & PQMD *38b*) which were entirely inactive on the duck; (2) growth on the filter paper and bleached sheeting was slightly greater than on the corresponding mineral salts-yeast extract controls, but no more so than might be expected to result from added impurities or mere mechanical stimulation; (3) growth of both categories of organisms was essentially proportional to the amount of yeast extract used; (4) the slight differences in the amounts of growth produced by the 4 strains are due to their ability to utilize the ingredients of the yeast extract rather than to their ability to act on the cellulose; (5) the essential factors brought out in this experiment and those on preceding pages is that certain strains of the *A. luchuensis* series have been shown to be capable of breaking down the cellulose of grey duck but not of commercial filter paper or commercial bleached sheeting.

Experiment 6. Action of Strain JQMD *190* of the A. luchuensis Series on Ground Filter Paper and Ground Bleached Cotton Cloth in Shaker Flasks with and without Yeast Extract (table 3). In view of the general failure of the organisms to act on bleached cotton cloth and on filter paper by the methods described in the preceding tests, the following experiment was undertaken to determine the behavior on these substrata, with and without yeast extract, employing the shaker technique previously described by Reese (1947).

Culture JQMD *190* was used because it was one of the most active, as measured by tensile strength tests, of the various strains tested on grey duck. As cellulose, 0.5 by weight of bleached cotton sheeting or filter paper was added, with and without yeast extract, to the mineral salts solution outlined below.[6]

Flasks of 250 ml. capacity, to each of which was added 25 ml. of the nutrient solution plus substrate, were subjected to standard autoclaving,

[6] In grams per l.: KH_2PO_4, 1.4; $MgSO_4 \cdot 7H_2O$, 0.75; NH_4NO_3, 1.0; $CaCO_3$, 0.005; NaCl, 0.005; $FeSO_4 \cdot 7H_2O$, 0.001; $MnSO_4$, 0.0001; water (deionized) to 1000 ml.

PQMD	*21e*	Tarpaulin	Russell Islands	11 Sept. 1944
"	*23b*	Manila rope	Espiritu Santos	6 Sept. 1944
"	*70c*	Australian shoe	Finschafen, N. Guin.	14 Oct. 1944
"	*102d*	Helmet lining, leather	" "	29 Nov. 1944
"	*124g*	Grey cotton duck	Panama Canal Zone	23 Dec. 1944
"	*155e*	Tentage	Munda, New Georgia	28 Mar. 1945
"	*321*	Salvage material	Phila. Naval Yard	1941
JQMD	*190*	Japanese tent	New Guinea	18 Sept. 1944
"	*228*	" tarpaulin	Hollandia, N. Guin.	10 Nov. 1944
"	*701*	Sidewall of tent	Port Moresby, N. Guin.	1 Mar. 1945
"	*745*	Tentage	" " "	9 Mar. 1945
"	*851*	Top of tent	Oro Bay, New Guin.	12 Apr. 1945

and after cooling were inoculated with 1 ml. of a spore suspension prepared by washing spores off a mat formed on a sucrose-mineral salts solution. The flasks were incubated on a shaker at a temperature of 23–26° C for three weeks. At the end of the incubation period the flasks were removed, 1 ml. of a 5.0 N NaOH solution was added to each, followed by autoclaving for 15 minutes, to destroy as much of the fungus substance as possible. The contents were then filtered on a gooch, dried, weighed, ashed, and reweighed. The difference in weights is a measure of the ash-free residue. The results are indicated in table 3.

The results presented in the table indicate that the organism probably exerted no action against either bleached cotton sheeting or filter paper. Addition of yeast extract or of sucrose resulted in losses of 2–3 per cent in three weeks. These data, however, are not adequate to establish statistical significance, but the loss, though small, is consistent. If it is to be regarded as significant, one has to assume an extremely small weight loss in proportion to decline in tensile strength if the results are to be regarded as other than in direct opposition to those presented in experiment 3.

TABLE 3. *Action of strain JQMD 190 of the A. luchuensis series on ground bleached sheeting and ground filter paper in shaker-flasks.*

Substrate	Residue							Loss in wt., %
	Of individual flasks, in mg.						Average	
Cotton, uninoc. controls	142	133	140	144	136	145	140	.....
Cotton, without yeast extract	138	143	146	141	137	.....	141	0
Cotton, 0.03 yeast extract	138	143	143	131	135	132	137	2
Filter paper, uninoc. controls	119	123	120	120	117	123	120	.....
Filter paper, without yeast extract	125	119	123	124	128	99	120	0
Filter paper, 0.03 yeast extract	116	108	119	119	114	119	116	3
Filter paper, 0.03 sucrose	109	110	126	113	129	113	117	2.5

Experiment 7. Action of Strains of the Aspergillus luchuensis Series on Bleached Cotton Sheeting in Close Proximity with Grey Cotton Duck (fig. 8, table 4). On the basis of the results thus far obtained it appeared probable that despite the lack of any attempts toward a high degree purification of either cellulosic substrate or culture medium the apparent differential in behavior of strains of the *A. luchuensis* series on grey cotton duck on the one hand and on the more highly purified bleached sheeting or filter paper on the other, was of a nutritional nature—that grey duck supplied certain nutritive factors necessary to cellulolytic activity which were not present in sufficient quantity in the sheeting and filter paper.

To determine this the following set of tests, a repetition of experiment 1 in all essential factors was conducted in which a strip of bleached sheeting

was superimposed on each strip of duck. The bleached strip was placed uppermost so that it fitted into the concavity of the duck, the two strips thus adhering closely together without any fastening being necessary. The inoculations, which have always been made by drawing the tip of the pipette upward from the solution to the top of the strip, were made in the same manner in this experiment, which means, of course, that the spore load was deposited on the sheeting.

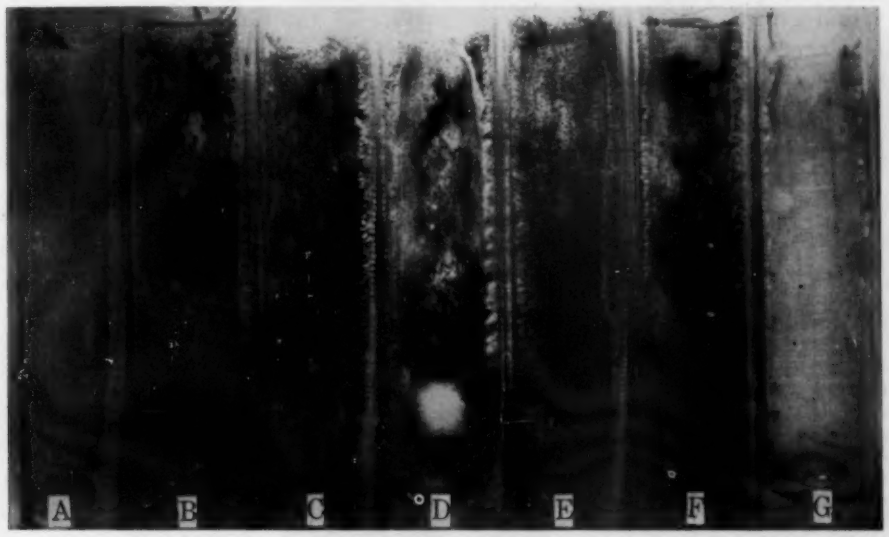

FIG. 8. Strains of the *Aspergillus luchuensis* series on strips of bleached cotton sheeting superimposed on strips of grey duck after an incubation period of 28 days. A, uninoculated control; B, *Chaetomium globosum* USDA *1042.4* for comparison; C–F, *Aspergillus luchuensis* series: C, PQMD *23b;* D, PQMD *102d;* E, PQMD *155e;* F, JQMD *190;* G, *A. niger,* TC *215–4247* for comparison. × 1.

The several strains of the *A. luchuensis* series which were used were selected from the previous tests, and as in previous tests *Chaetomium globosum,* USDA *1042.4,* and *Aspergillus niger,* TC *215–4247,* were carried along for comparison.

The grey duck used was of 12 oz. weight, from the same lot as that of experiment 1, breaking at 170 lbs. on the Scott tester, while the sheeting was 3.3 oz. weight breaking at about 37 lbs.

The strains employed, the incubation intervals, and results in terms of percent tensile strength retained at harvest are indicated in table 4. The percentages are based on controls of each type of cloth incubated but not inoculated and recorded as 100. Five replicates were employed in each case.

At the 14- and 28-day (figure 8) harvests the growth patterns did not

differ markedly from each other or from those described for previous tests. The strips inoculated with *Ch. globosum* were well covered with perithecia, the greatest concentration being just above the water line, which also was the point of greatest cellulolytic action. Those inoculated with strains of the *luchuensis* series showed a heavy and for the most part evenly distributed growth on all above-water portions of the strips except where they were in direct contact with the glass. Breakage points were at random on the above-liquid portions of the strips. In the case of *A. niger* the only visual growth was a pellicle on the surface of the liquid and very sparse and aborted fruit bodies mostly at the extreme upper ends of the strips, with breakage completely at random.

TABLE 4. *Cellulolytic action of strains of the Aspergillus luchuensis series on bleached cotton sheeting in close proximity with grey duck.*

Organism	Per cent strength retained after incubation				Final pH of sol'n
	14 days		28 days		
	Grey duck	Bleached sheeting	Grey duck	Bleached sheeting	
Uninoc. control	100	100	100	100	7.1
Chaetomium globosum, USDA *1042.4*	2.0	0	0	0	6.7
A. luchuensis series, PQMD *23b*	68	61	40	35	6.7
A. luchuensis series, PQMD *102d*	56	49	32	30	4.0
A. luchuensis series, PQMD *155e*	55	48	40	36	7.0
A. luchuensis series, JQMD *190*	60	58	37	40	6.4
Aspergillus niger, TC *215–4247*	103	103	104	103	7.6

The pH readings given in the table are averages for 5 replicates but in no case, except for PQMD *102d* which varied from 3.8 to 4.2, was the variation among replicates greater than a few hundredths of a unit.

Experiment 8. Summarizing Assay of Strains of the Aspergillus luchuensis Series on Grey Duck (figs. 9–10, table 5). There were at hand strains of the *A. luchuensis* series which had not yet been tested for cellulolytic action, namely PQMD *321*, JQMD *701*, and JQMD *851*. Strain PQMD *124g* had been tested only on bleached sheeting (White, Darby et al.) and had given negative results. Two strains, PQMD *21e* and NRRL *358*, when tested on grey duck, had exhibited, at best, very weak action, although in showing a certain amount of activity and growth they behaved true to type as strains of the *A. luchuensis* series in contrast to strains of other species of the *A. niger* group. Seven strains, PQMD *23b*, *70c*, *102d*, *155e*, JQMD *190*, *228*, and *745* had exhibited somewhat stronger action and more growth than PQMD *21e* and NRRL *358*.

The following test was conducted to check the foregoing results by testing all cultures concurrently.

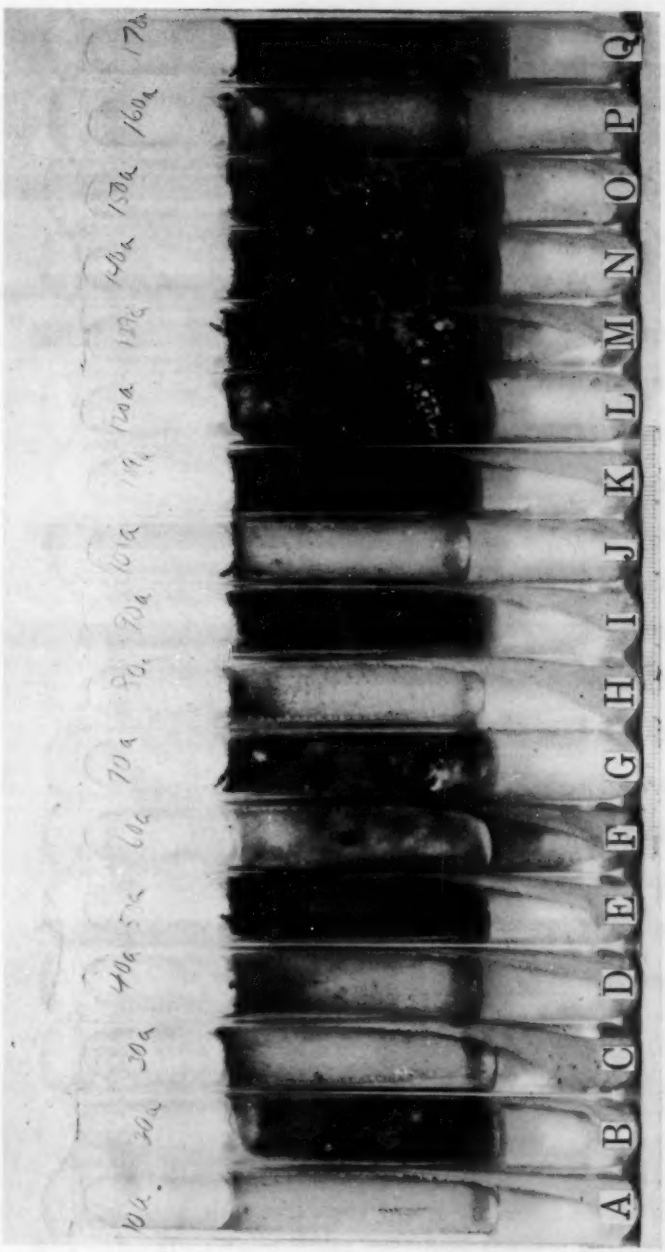

FIG. 9. Comparative growth patterns and amounts of growth produced by various strains of the *A. luchuensis* series on strips of grey cotton duck after a 6-weeks incubation period. A, uninoculated control; B, *Chaetomium globosum*, USDA *1042.4*, for comparison; C, *A. niger*, TC *215–4247*, for comparison: D–O, Unnamed members of the *A. luchuensis* series: D, PQMD, *21e*; E, PQMD *23b*; F, PQMD *70c*; G, PQMD *102d*; H, PQMD *124g*; I, PQMD *155e*; J, PQMD *321*; K, JQMD *190*; L, JQMD *228*; M, JQMD *701*; N, JQMD *745*; O, JQMD*851*; P–Q, *A. japonicus*: P, NRRL *358*; Q, NRRL *359*. ×½.

The methods and procedures were as in experiment 1 except that the test tubes used were of soft glass instead of Pyrex and the incubation periods were lengthened.

The results are presented in figures 9 and 10 and table 5.

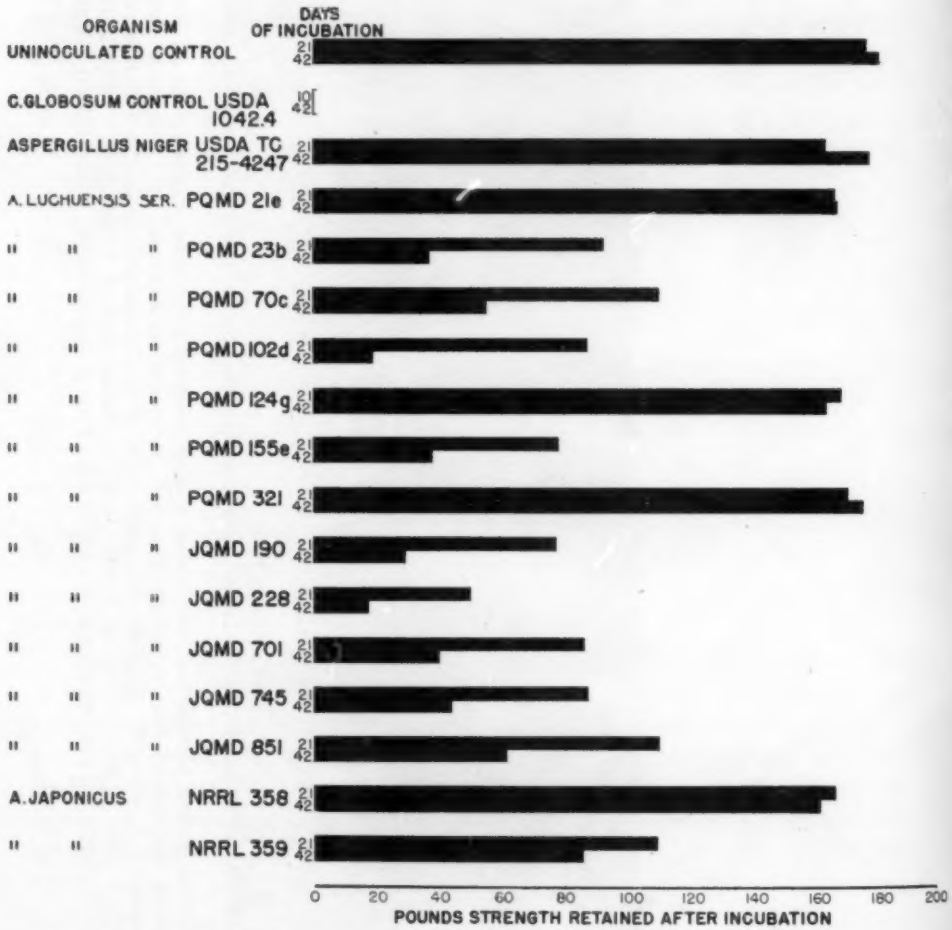
ORGANISM
DAYS OF INCUBATION
UNINOCULATED CONTROL
C.GLOBOSUM CONTROL USDA 1042.4
ASPERGILLUS NIGER USDA TC 215-4247
A. LUCHUENSIS SER. PQMD 21e
" " " PQMD 23b
" " " PQMD 70c
" " " PQMD 102d
" " " PQMD 124g
" " " PQMD 155e
" " " PQMD 321
" " " JQMD 190
" " " JQMD 228
" " " JQMD 701
" " " JQMD 745
" " " JQMD 851
A. JAPONICUS NRRL 358
" " NRRL 359
0 20 40 60 80 100 120 140 160 180 200
POUNDS STRENGTH RETAINED AFTER INCUBATION

FIG. 10. Summarizing assay of cellulolytic activity of strains of the *A. luchuensis* series on grey cotton duck.

FIELD OCCURRENCE

The cultures of the *A. niger* group that are dealt with in this paper, with the exception of PQMD *321* (see table below), TC *215–4247*, and those furnished by Dr. Raper (NRRL), were isolated from military materials that had undergone deterioration in the tropics. The samples of mate-

rials were received as a result of requests sent out to the various theatres by Prof. W. H. Weston who was at that time Consultant to the Office of the Quartermaster General on mold problems. Each sample was wrapped to preclude air contamination in transit and was accompanied by certain pertinent information which had been requested. But although the utmost precautionary measures were taken to prevent contamination of the sample between the points of field preparation for shipment and the opening of the package in our own transfer room there still remains the fact that the appearance of a species in the petri dish in isolation attempts in the laboratory does not in itself constitute any criterion of the activity of that species on the particular sample.

TABLE 5. *Final pH readings of solutions.*[a]

Organism	pH of solution	
	After 3 week incub. period	After 6 week incub. period
Uninoc. control	7.2	7.1
Chaetomium globosum, USDA *1042.4*	7.0	6.5
A. niger, TC *215–4247*	7.6	7.4
A. luchuensis series, PQMD *21e*	7.3	7.2
A. luchuensis series, PQMD *23b*	6.7	6.3
A. luchuensis series, PQMD *70c*	6.8	6.0
A. luchuensis series, PQMD *102d*	4.0	3.9
A. luchuensis series, PQMD *124g*	7.2	7.0
A. luchuensis series, PQMD *155e*	7.0	6.9
A. luchuensis series, PQMD *321*	7.5	7.3
A. luchuensis series, JQMD *190*	6.5	5.8
A. luchuensis series, JQMD *228*	6.3	4.3
A. luchuensis series, JQMD *701*	6.7	6.4
A. luchuensis series, JQMD *745*	6.7	6.3
A. luchuensis series, JQMD *851*	6.7	6.2
A. japonicus, NRRL *358*	7.3	7.0
A. japonicus, NRRL *359*	6.9	6.7

[a] Original solution after autoclaving 7.2.

The name of the item, the region from which it came, and date and place of isolation for each of the cultures identified as belonging in the *A. luchuensis* series is shown below. The isolates with the exception of PQMD *321*, were made either at the Philadelphia or the Jeffersonville (Indiana) Quartermaster Depots, as indicated by the prefix to the assession number. They have been maintained on potato dextrose agar slants.

The samples from which the PQMD series of isolates were made were preserved and were carefully re-examined before this writing. Although most of them have one or more species of fungi fruiting on the surface, there are none which upon careful microscopic examination exhibit any structures reminiscent of those of members of the *A. niger* group. This is

illustrative of the experience of the writers in making examinations and isolations from hundreds of samples of molded fabrics, paper, and like materials. In our laboratory, isolations from fabrics have usually been made by removal of fibers or threads from the sample and planting them on several kinds of agar media including potato dextrose, acidified potato dextrose, nutrient, cellulose dextrin, and often also filter paper strips partially immersed in a mineral salts solution. In these procedures, black *Aspergilli* appear very frequently, especially on the sugar media. Actual proof that

FIG. 11. Woolen trousers of Australian manufacture showing heavy infestation of the heavily sized cotton lining materials by a member of the *A. niger* group. This is one of several pairs in similar condition, unused, taken by the senior author from a wooden carton in a U. S. Army Quartermaster warehouse on Biak Island. Excessive dampness was caused by periodic flooding of the coral floor to a depth of about 6 inches with the water at times touching the bottom of the carton. × ¾.

they are present on the samples other than merely as spores deposited with the dust of the atmosphere is still to be forthcoming. The evaluation of the relation of any one species of fungus to field damage is a very difficult problem to get at. It is still possible, even though the black *Aspergilli* are not among the species that fruit readily on such materials, that through continuous spore deposit, followed by germination and restricted vegetative growth from the energy of the spore and the small amount of nutrient furnished by incidental dirt, there may be considerable deleterious action, especially against fungicides and finishing materials, which may in the aggregate be great.

On the rare occasions when black *Aspergilli* actually have been found in an identifiable state on cotton fabrics, it has been apparent that it was sizing rather than the fabric itself that was furnishing the necessary nutrients. It may be pointed out here that during the period of the 1920's when "*Aspergillus niger*" was mentioned so frequently by those concerned with mold problems in the British cotton textile industry, that the emphasis was on attack of the sizing rather than the base fabric. Flimsy, lightweight fabrics are as a rule more heavily sized than heavy-weight military fabrics, and in so far as can be stated at present it is on the former that the black *Aspergilli* are most apt to be troublesome. In figure 11 is illustrated a severe case of growth in the heavily sized white cotton lining materials of a pair of wool trousers of Australian manufacture. This pair, along with several others in a similar condition, was encountered by the senior author (White 1946) in a U. S. Army Quartermaster warehouse on Biak Island. They had never been issued. The wooden carton in which they were packed was resting on a crudely devised platform about six inches off the coral floor of the open-side shed. Periodic flooding of the floor to a depth of about six inches so that the water touched the bottom of the carton had caused an excess of moisture to be drawn up through the clothing. No growth was found on the wool portions of the garments and the strength of the heavily molded cotton parts did not appear to have been greatly, if at all, reduced. The organism was not a member of the *A. luchuensis* series.

It may be pointed out, incidentally, that members of the *A. niger* group (not identified more specifically) sporulate in profusion on leather products. On shoes stored in humid tropical atmospheres they are often found in solid black mats on the soles, and especially on leather insoles.

SUMMARY

1. In a previous paper (White, Darby et al. 1948) plus the present one, a total of 52 isolates of black *Aspergilli* were tested for ability to decompose cellulose. Of this number, 37 were taken from deteriorated military cotton fabrics and similar materials during the war, 14 were obtained from Dr. Raper of the Northern Regional Laboratory and were of long pure-culture history, and one was the well known and so-called official strain for the assessment testing of mildew-proofness, i.e., TC *215–4247*. They represented a wide range of forms distributed among at least 10 of the 15 taxonomic entities currently recognized in the *Aspergillus niger* group.

2. None of the truly black *Aspergilli* were found to be capable of cellulolytic action. Such activity was confined to the ochraceous *A. niger* mutant *Schiemannii* and to the more or less purple-brown forms which comprise the *A. luchuensis* series. The results seem to warrant the general conclusion that within the *Aspergillus niger* group cellulolytic ability is absent in

the *A. niger* series and *A. carbonarius* series but is, in contrast, a fairly constant feature of the *A. luchuensis* series.

3. Activity was, however, not demonstrated for all the 16 isolates falling within the *A. luchuensis* series. Of 12 strains isolated from military materials, none of which were identified to species, nine gave positive results of about an equal order of magnitude, one (PQMD *21e*) was weak or doubtful, and two (PQMD *124g* and *321*) gave negative results. Of the 4 specifically identified isolates obtained from Raper, *A. luchuensis* and *A. violaceo-fuscus* showed no activity, while for *A. japonicus* strong activity was demonstrated for one culture and weak or doubtful activity for the other. Further study of cellulolytic activity in relation to the current species concepts within the *A. luchuensis* series is highly desirable.

4. The foregoing conclusions are based on decline in tensile strength of strips of cotton fabric. When loss in weight of ground cellulose in liquid cultures or visual growth on filter paper were taken as measures of cellulolytic activity the results were negative, the data being inadequate, however, for the drawing of definite conclusions. Members of the *A. luchuensis* series which were inactive on strips of bleached cotton sheeting partially immersed in a mineral salts solution readily attacked the sheeting when strips of less highly purified grey duck were placed adjacent to them in the vessel, the evidence being that the nutrition of these fungi is not of the simplest type.

5. Under field conditions the black *Aspergilli* have been found in an identifiable, i.e., sporulating, condition only on light-weight heavily sized fabrics, usually in storage or transit. They appear frequently in isolation procedures from tentage and other heavy size-free military fabrics but there is no evidence that they exist on the material as other than spores deposited with the dust of the atmosphere. It is possible, however, that under field conditions these fungi may through the process of constant and repeated spore germination and slight vegetative growth resulting from incidental dirt do damage to fungicidal and other finishing treatments which may in the aggregate account for considerable economic loss. They are known to be capable of attacking a wide range of materials and to have generally high fungicidal tolerance.

6. In the laboratory, strains of the *A. luchuensis* series have equaled or excelled those of other members of the *Aspergillus niger* group in growth and activity on cellulosic materials and should be given further consideration for possible use in assessment testing for mold-proofness of such materials. Recommendation for such use is withheld, however, pending further work on their nutrition in relation to decomposition of cellulosic materials and a determination of their relative fungicidal tolerances.

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PHILADELPHIA, PENNSYLVANIA

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PLANT EXPLORATIONS IN GUIANA IN 1944, CHIEFLY TO THE TAFELBERG AND THE KAIETEUR PLATEAU—VI[109]

BASSETT MAGUIRE AND COLLABORATORS

ARACEAE[110]

The aroids of the Guianas are evidently little known. This may be well illustrated by the following lists of specimens, collected in British Guiana and Surinam by Bassett Maguire, D. B. Fanshawe, and Gerold Stahel. Of a relatively small number of plants, four constitute apparently new species, and for one of these a new genus must be erected. Since three of the novelties were found in the presumably well collected area of Zanderij, we may feel safe in assuming that the araceous flora of the entire region still contains many undetected species.

The relationship of the Araceae of the Guianas is principally with the Amazonian species of northern Brazil, but plants from Venezuela, Colombia, Peru, Trinidad, and Tobago, have also found their way into the area. Endemism among the Guianan aroids is negligible.

ANTHURIUM AMOENUM Kunth. BRITISH GUIANA: epiphyte, Mora Forests, Kamuni Creek, Groete Creek, Essequibo River, frequent, *22823*. A small phase of this widespread and polymorphic species, known in its typical and varietal forms from Venezuela, Colombia, and Peru.

ANTHURIUM GALEOTTII (Hort.) C. Koch. SURINAM: epiphyte in ants' nest, mixed wallaba forest, km. 10, vicinity Kwatta Camp (3), Coppenam River Headwaters, *24860*. Also known from Brazil, mostly in the south-central area.

ANTHURIUM HOOKERI Kunth. SURINAM: terrestrial, high forest, base of south cliffs, frequent, Arrowhead Basin, Tafelberg, *24458*. A splendid large phase of this spectacular and variable big aroid, which is widely distributed in the West Indies and northern South America.

ANTHURIUM KUNTHII Poepp. & Endl. BRITISH GUIANA: spathe green, spadix purple, occasional epiphytic perennial herb usually 4–5 m. up on trees, trail from Tukeit to Kaieteur Plateau, *23061*. This showy species, with large digitate foliage, has previously been recorded from Brazil and Peru.

Anthurium Maguirei A. D. Hawkes, sp. nov. Herba terrestris, parva, variabilis; rhizoma abbreviatum, repens; folia erecta, variabilia; lamina coriacea, elliptica vel obovato-elliptica vel lanceolato-elliptica, ad apicem acuta vel obtusa vel leviter mucronata; nervi prominentes, adscendentes, confluentes; inflorescentia erecta, variabilis; pedunculus cylindricus; spatha erecta vel reflexa, ovato-lanceolata, acuta vel obtusa, leviter undulata, viridis; spadix erectus, cylindricus; flores subquadrati.

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[109] This is the concluding part of the report on the 1944 Guiana explorations. The preceding five parts have appeared under the above title as follows: Bull. Torrey Club 75: 56–115, 189–230, 286–323, 374–483, 522–579. 1948.

[110] By Alex D. Hawkes.

Low terrestial herb, variable in stature and foliage-form. Plants varying from 13.5–33.5 cm. high. Rhizoma rather abbreviated, repent, producing erect leaves and inflorescences at variable intervals, ca. 1.5 cm. in diameter, mostly concealed by the chartaceous, reddish-brown sheaths which gradually deteriorate with age. Leaves stiffly erect, variable, 9.5–33.0 cm. high (including petiole). Petiole 2.5–21.5 cm. high, usually ca. 2 mm. in diameter, rather angular, typically with a deep rather triangular groove running down the front and a somewhat thickened pulvinus at base of blade, broadening slightly basally. Blade 7.5–16.0 cm. long, 2.2–6.5 cm. wide, rather leathery, elliptic to obovate-elliptic or lanceolate-elliptic in shape, with an apex varying from acutish to obtuse or minutely mucronate; veins very prominent on both surfaces, variable in number and size, but with the secondaries always strongly ascending and more or less confluent in a vein which follows the margin of the blade just inside its periphery. Inflorescences rigidly erect, up to 39 cm. high, shorter than or longer than foliage. Peduncle cylindric, to 32 cm. high, ca. 2 mm. in diameter, widening considerably at base. Spathe erect or reflexed, ovate-lanceolate, acute or obtuse, to 3 cm. long and 6 mm. broad, rather undulate, green (fide coll.). Spadix stiffly erect, 2.5–7.0 cm. long (including naken basal portion), cylindrical, ca. 5 mm. in diameter when mature, brownish when dried. Flowers usually with 4 anthers, almost quadrate.

TYPE: leaves coriaceous, spathe and spadix green, frequent bogs border or low bush, Savanna I, Tafelberg, Surinam, August 3, 1944, *Maguire 24218*. New York Botanical Garden.

Anthurium Maguirei is an interesting dwarf species of extremely variable habit, of the section *Xialophyllium* Schott, and is allied to *A. amoenum* Kunth. The excellent series of specimens available under the type number exhibits wide extremes of plant size and foliar shape. It is an attractive small aroid. I take great pleasure in naming it for its discoverer, Bassett Maguire, of the New York Botanical Garden.

ANTHURIUM NIGRESCENS Engl. SURINAM: locally frequent at Cataract 3, Augustus Falls, Tafelberg, *24763*. Previously reported from Colombia. A large species with an olive-green spathe and dark brown spadix.

Anthurium Stahelii A. D. Hawkes, sp. nov. Herba epiphytica; rhizoma elongatum, scandens; petiolus erectus, cylindricus; lamina erecta, rigida, undulata, sagittato-lanceolata, ad apicem acuminata, ad basim lobata; lobi posteriores triangulo-oblongi, obtusi vel truncati; nervi medii prominentes; nervi secondarii ca. 10–12, arcuati, supra obscuri; pedunculus erectus, unicus, cylindricus; spatha magna, erecta vel semi-erecta, ovata vel oblongo-ovata, valde acuta, striata intus, extus glabra; spadix erectus, cylindricus, tenuis, ad apicem attenuatus, obtusus, ad basim nudus; flores quadrangulares vel sexangulares, irregulares.

Epiphytic herb. Rhizome elongate, climbing, ca. 1.5 cm. in diameter, at intervals emitting wiry roots to 1.5 mm. in diameter, with a somewhat roughened and gradually deciduous bark. Petioles erect, apparently cylindric, to 5 cm. high, narrowing slightly toward apex, ca. 1 cm. in diameter, broadening slightly at base. Leaf-blade erect, evidently rather rigidly so, plane, with a slightly undulate margin, 25–35 cm. long, 11.5–18.0 cm. across basal lobes, sagittate-lanceolate, with an apical acumen about 1.5 cm. long, and deep triangular-oblong basal lobes up to ca. 10.5 cm. long and 6

cm. broad which are obtuse or almost truncate at the apex; median vein very prominent, with a strong secondary curving from its base into each basal lobe; secondaries ca. 10–12 on each side, arcuate, sharply downcurved almost at margin, rather obscure on upper side of leaf. Peduncle erect, solitary, 13–24 cm. high, with a basal sheath which is soon deciduous, cylindric, to 4 mm. in diameter. Spathe large and showy, color unknown, apparently erect or semi-erect, ca. 10 cm. long and ca. 5.5 cm. across, ovate or oblong-ovate, with a sharply acute apex, somewhat striate within, rather smooth outside. Spadix erect, cylindric, slender, 8.5–9.5 cm. long, 5.0–5.5 mm. in diameter, narrowing slightly to a rather blunt apex, the basal naked portion ca. 5 mm. long. Flowers quadrangular or sexangular, irregularly shaped, apparently opening slowly and gradually toward the apex.

TYPE: epiphyte, forest, east side, Savanna I, Zanderij, Surinam, October 20, 1944, *Maguire & Stahel 25049*. New York Botanical Garden.

The species is named in honor of Dr. Gerold Stahel, Director of the Agricultural Experiment Station, Paramaribo, Surinam, one of the collectors of the type. It is a member of the section *Calomystrium* Schott, but is apparently not closely allied with any described species of that group.

DIEFFENBACHIA SEGUINA (L) Schott. SURINAM: terrestrial, locally abundant about foot of waterfalls and under drip of the north escarpment, Tafelberg, *24289*. A highly variable aroid with numerous described varieties and sub-varieties which are extensively distributed in the West Indies, Central America, and northern and central South America. It is often cultivated for the beautifully variegated foliage, which when eaten may produce severe paralysis of the vocal chords and swelling of the facial muscles. The specific name is sometimes erroneously spelled "seguine."

HETEROPSIS JENMANI Oliv. SURINAM: swamp, km. 1, vicinity of Base Camp, Tafelberg Creek, *24120*. Previously considered endemic to British Guiana. Jenman, Hook. Ic. **20**: *pl 1949* (1890), writes: "The plant grows up the stems of trees, from which it sends down long aerial roots, which split into thin strips, form the most useful tying material the Indians employ."

Maguirea spathicarpoides A. D. Hawkes, gen. et sp. nov. Herba terrestris, erecta; caudex subterraneous, verticalis; radices crassae; foliae erectae, virides, coriaceae, ad basim conduplicatae; petiolus crassus, fortiter conduplicatus; lamina magna, glabra, obovato- vel lineari-lanceolata, breviter acuminata; nervus medius prominens; nervi secondarii adscendentes, numerosi, ad marginem confluentes; inflorescentia ex basi emergens, magna; pedunculus erectus, ad basim attenuatus; spatha viridis, coriacea, erecta, elliptico-lanceolata vel oblanceolata, involuta, ad apicem breviter cucullata, acuminata, ad basim leviter plicata, undulata; spadix ad spatham adnatus, parte apicali sterili excepta, in segmentum compressum redactus; flores feminei gemini, plus minusve oblongi; flores masculi 3–5 ad cuiusque floris feminei basim producti, sessiles vel leviter pedicellati, rectangulares; pars apicalis sterilis, libera, attenuata.

Erect terrestrial herb. Stem subterranean, vertical in soil, up to about 12 cm. long in our specimens, to 3 cm. in diameter, with numerous rough annular rings and a few fleshy roots. Foliage mostly erect, dark green (fide coll.), coriaceous when dry, apparently flaccid and rather fleshy when fresh, conduplicate and fleshier basally. Petioles to 32 cm. long, 6 cm.

across when expanded, but usually folded in two, about 3 cm. thick, fleshy. Blades (with petiole) to 10.9 cm. long, ca. 15 cm. wide, glabrous, obovate-lanceolate to almost linear-lanceolate, shortly acuminate at tip, with a very large (to 1.5 cm. wide toward base) median vein and numerous ascending secondaries which are confluent toward margins. Inflorescence arising from basal side of leaf-cluster, including the spathe up to 65 cm. long. Peduncle mostly about 1 cm. in diameter, usually somewhat narrowing basally, erect. Spathe light greenish (fide coll.), to 30 cm. long, 5–6 cm. wide below middle, coriaceous, erect, elliptic-lanceolate to somewhat oblanceolate, rather involute, slightly hooded apically, acuminate, a little plicate at base, undulate, especially toward tip. Spadix adnate to spathe, except for apical sterile portion, to ca. 16 cm. long and ca. 1 cm. or less across, reduced to a flattened segment with slightly raised margins on which the flowers are borne; female flowers paired (solitary toward base of spadix), more or less oblong in shape, ca. 5 mm. long, 3 mm. broad, and 2 mm. high; male flowers 3–5 at base of each female flower, sessile or slightly stalked, ca. 0.25 mm. high, rectangular when dry; sterile portion apical, free, of unknown length, narrower than fertile section.

TYPE: Bog terrestrial, Sectie O, vicinity km. 68, Surinam, October 19, 1944, *Maguire & Stahel 24998,* New York Botanical Garden.

This unusual new genus is apparently referable to the tribe Asterostigmateae, of the subfamily Aroideae, its closest described ally being Hooker's group *Spathicarpa*. I take great pleasure in dedicating this strange novelty to its discoverer, Bassett Maguire, of the New York Botanical Garden.

MONSTERA FALCIFOLIA Engl. BRITISH GUIANA: hemi-epiphyte rooted in ground and attached to tree by short adventitious roots from a *Bactris* palm in *Euterpe* swamp, leaves thinly fleshy, spathe fallen, spadix oblong in fruit, fruit hexagonal on surface, orange, Baramanni Creek, Waini River, N.W.D., *F2346*. The spathe of this species is typically yellowish. It is known from the Brazilian Amazon region, and Bolivia.

MONSTERA MILLERIANA Schott. BRITISH GUIANA: fleshy hemi-epiphyte with thick, 3–4 cm. diameter stem attached by short adventitious roots to *Spondias* tree from secondary forest but rooted in ground, leaf-bases clasping, petioles canaliculate, leaves thinly fleshy, flower spikes axillary, subtended by outer pair of amplexicaul, inner pair of sheathing bracts, spathe whitish, tightly rolled in bud, fruit spadix green-blue, oblong, Mabaruma, Aruka River, N.W.D., *F2473*. Probably endemic. Sometimes referred to *M. pertusa* (L.) DeVriese, but evidently distinct from that polymorphic species.

MONSTERA PERTUSA (L.) De Vriese. SURINAM: epiphytic on *Ceiba*, coastal jungle, near km. 60 along Carl Francois road from Paramaribo, *23601*. A highly variable species with several varieties, in Mexico, Central America, the West Indies, and much of South America.

MONSTERA PERTUSA (L.) De Vriese var. JACQUINII (Schott) Engl. SURINAM: a climber rooted in the soil, spathe cream-colored, white in bud, frequent, mixed forest, km. 10, Tafelberg Creek, *24083;* epiphyte, forest, east side, Savanna I, Zanderij, *25055*. Highly variable, with about the same distribution as the species.

MONTRICHARDIA ARBORESCENS (L.) Schott. SURINAM: Saramacca River banks, vicinity of Saron Creek, *23768*. A gregarious species found in the

West Indies, Central and South America, which grows principally along the edges of streams and rivers, in great clumps often to 3 meters or more high.

PHILODENDRON BROADWAYI N.E.Br. BRITISH GUIANA: climbing epiphyte, frequent, More forest, Kamuni Creek, Groete Creek, Essequibo River, *22862*. Also found in Tobago, Trinidad, and Venezuela.

Philodendron cyclops A. D. Hawkes, sp. nov. Planta scandens, robusta, epiphytica; caudex articulatus, magnus; petiolus cylindricus, ad apicem leviter attenuatus, ad basim expansus; lamina quam maxima, coriacea, pendens, utrinque glabra, leviter undulata, sagittato-elliptica, ad basim fortiter lobata ad apicem undulata, acuta; lobi posteriores magni, ovato-triangulares; obtusi vel truncati; nervus medius magnus, nervi laterales 2, obliqui, adscendentes; nervi secondarii ca. 8, leviter arcuati, ad marginem evanescentes; pedunculus erectus, 2 (vel plures?), ex vagina apicali orientes, leviter arcuatus, teres; pedicellus erectus, ad basim spathae expansus; spatha erecta, geminata, convoluta, ovato-lanceolata vel lanceolata, fortiter acuta, coriacea, rigida; spadix erectus, angustus, ad basim inerassatus.

Robust epiphytic vine. Stems climbing, of unknown length, prominently jointed, ca. 3 cm. in diameter, with a tan, flaky bark and often with rigid portions of the old leaf-petioles attached. Petioles apparently cylindric, narrowing slightly at apex and broadening basally, 57 cm. long and about 1 cm. in diameter in our specimen. Leaf-blade very large (only one present), 63 cm. long, ca. 33 cm. across near middle, apparently rather coriaceous, probably pendent, glabrous on both surfaces, very slightly undulate on margins, sagittate-elliptic, with two deep basal lobes and a gradually acute apex which is evidently more prominently undulate than the rest of the blade; basal lobes very large, rather ovate-triangular, with an obtuse or truncate apex, 21.5–23.0 cm. long, 18–19 cm. across; median vein very large, ca. 7 mm. across near base, giving rise to two obliquely ascending veins which extend to apex of lateral lobes; secondaries ca. 8 on each side, only slightly arcuate, disappearing toward margins; tertiary veins rather prominently raised, mostly parallel to margins. Peduncles erect, two (or more?) together from apical sheath, slightly curved, ca. 20 cm. long and 5 mm. in diameter, broadening at base and apex, apparently cylindric. Pedicels erect, ca. 4 cm. long and 5.5–6.0 mm. in diameter, widening toward junction with base of spathe. Spathe erect, double, the two sections rather tightly folded around each other and apparently not opening very much to expose the spadix, 15.5–17.5 cm. long, ca. 2.0–2.5 cm. in diameter, ovate-lanceolate or lanceolate, sharply acute at apex, coriaceous, rigid on drying. Spadix erect, ca. 15 cm. long, slender, ca. 12 mm. in diameter near base, 9–10 mm. in diameter toward apex, with a rather prominent bulge (sterile portion) above female inflorescence which reaches 14 mm. in diameter; female portion ca. 5.5 cm. long; male portion (including sterile area) ca. 9 cm. long.

TYPE: epiphyte, forest, east side Savanna I, Zanderij, Surinam, October 20, 1944, *Maguire & Stahel 25052*. New York Botanical Garden.

A large and spectacular epiphytic species, among the most robust of the genus, with great horticultural possibilities.

PHILODENDRON DEMERARAE Gleason, vel aff. BRITISH GUIANA: epiphyte, leaves sagittate, Kaieteur Plateau, *23412*. Apparently endemic.

PHILODENDRON LACINIATUM (Vell.) Engl. SURINAM: epiphyte, climbing

on rocks, or terrestrial, frequent, high forest, base south cliffs, Arrowhead Basin, Tafelberg, *24483*. This highly variable plant, found as well in British Guiana and Brazil, has characteristically deeply-lobed foliage and often attains large dimensions.

PHILODENDRON NOBILE Bull. BRITISH GUIANA: epiphyte, spathe white outside, crimson within, frequent, Kaieteur Plateau, *23409;* epiphyte, Kaieteur Plateau, *23412a*. SURINAM: terrestrial or epiphytic, spathe bright orange-red within, whitish outside, spadix white, frequent, high mixed forest northeast of Savanna II, Tafelberg, *24405*. A very showy aroid, with immense elongate oblanceolate leaves which superficially resemble those of the fern *Asplenium Nidus* L.; also known from Brazil.

PHILODENDRON SURINAMENSE Engl. BRITISH GUIANA: hemi-epiphyte rooted in the ground clinging to tree by short adventitious roots from a *Euterpe* in *Euterpe* swamp, leaves thinly fleshy, with winged canaliculate petioles, spathe green, tightly enclosing spadix except tip, spadix male flowers creamy-brown, female green, Baramanni Creek, Waini River, N.W.D., *F2343*. A little-known species, previously recorded only from Surinam.

PISTIA STRATIOTES L. BRITISH GUIANA: wallaba forests, Bartica-Potaro Road, *23561*. A rather small phase of this cosmopolitant acquatic aroid.

RHODOSPATHA LATIFOLIA Poepp. BRITISH GUIANA: climbing epiphyte, Mora forest, Kamuni Creek, Groete Creek, Essequibo River, *22883*. Also known from Peru and Brazil; a showy species.

RHODOSPATHA SPRUCEANA (Schott.) Macbr. BRITISH GUIANA: epiphyte, leaves fleshy, spadix pale orange, occasional, wallaba forest, Kaieteur Plateau, *23328*. Previously found in Peru, Brazil, and Colombia.

SPATHIPHYLLUM CANNAEFOLIUM (Dryand.) Schott. BRITISH GUIANA: perennial fleshy tufted herb of *Manicaria* swamp, material is larger in all parts than that normally encountered in the swamp forest, leaves erect on long stalks, spathe open, green on reverse, white, glossy on upper face, spadix pale cream, Mabaruma, Aruka River, N.W.D., *F2388*. A showy species which is occasionally cultivated, indigenous to Trinidad, Venezuela, Colombia, and probably Brazil.

STENOSPERMATUM SPRUCEANUM Schott. SURINAM: terrestrial, inflorescence nodding, spathe white, infrequent in high forest, base of south cliffs, Arrowhead Basin, Tafelberg, *24459;* climbing epiphyte, spathe white, high forest, 300 m. south-east Ridge, Tafelberg, *24556*. Also known from British Guiana, Brazil, Peru, and Colombia. A showy and attractive plant.

SYNGONIUM TERNATUM Gleason. SURINAM: spathe yellow, frequent epiphyte, primary jungle, Charlesburg Rift, 3 km. north of Paramaribo, *22800*. Previously reported only from British Guiana.

UROSPATHA SAGITTIFOLIA (Rodsch.) Schott. BRITISH GUIANA: terrestrial, inundated river-banks, spathe chocolate-colored, rare, Potaro River, Kaieteur Plateau, *23393*. Also known from French Guiana and Brazil. A strange and spectacular aroid, exhibiting a predilection for a semi-aquatic habitat.

XYRIDACEAE[111]

XYRIS DOLICHOSPERMA Lanj. BRITISH GUIANA: locally frequent, from damp sand, Kaieteur Plateau, *23234;* locally frequent from boggy places,

[111] By J. Lanjouw and J. C. Lindeman.

Kaieteur Plateau, *23317*. SURINAM: grass savanna near Zanderij II, *23647;* locally frequent, border of seeps, with *Commelina*, *Drosera* in *Sphagnum*, Savanna VIII, Tafelberg, *24528*. This species seems to be rather common both in British Guiana and in Surinam.

XYRIS SURINAMENSIS Spreng. BRITISH GUIANA: common in damp sand, Kaieteur Plateau, *23141*. SURINAM: frequent in grass savanna near Zanderij II, *23672;* South Savanna, vicinity Arawak village at Mata, *24980*. A common species in Guiana and the Amazon region.

XYRIS PARAENSIS Poepp. apud. Kunth. SURINAM: frequent in grass savanna near Zanderij II, *23674*. This species seems to be rather rare in Surinam.

XYRIS LONGICEPS Malme. SURINAM: frequent in wet savanna near Zanderij I, *23718;* wet open places on rock, Savanna III, Tafelberg, *24259;* frequent, wet sphagnum-filled cracks in rocks, Savanna IV, Tafelberg, *24395b;* frequent in grass savanna near Zanderij II, *23673*. This species is common in Surinam. It is remarkable that it has not yet been reported from British Guiana, though undoubtedly it must occur there too.

XYRIS ULEANA Malme. BRITISH GUIANA: locally frequent, from stream bed, Kaieteur Plateau, *23386*. SURINAM: infrequent in Savanna I, Tafelberg, *24202;* frequent on wet places with Cyperaceae on rocks in Savanna II, Tafelberg, *24259a;* frequent in cracks of rocks, bed of Lisa Creek, near falls, Tafelberg, *24384*. This rare species is apparently common on Tafelberg.

XYRIS SPATHACEA Lanj. SURINAM: common in grass savanna near Zanderij II, *23664*. A second record of this endemic species, collected not very far from the type locality.

XYRIS GLABRATA Griseb. BRITISH GUIANA: locally common in damp sand and shallow crevices, Kaieteur Plateau, *23164*.

Note: This specimen is somewhat doubtful. It differs from the typical *X. glabrata* in the following characteristics: Leaves with a rugulose surface in the sheathing part and with dentate-scabrous margins, sometimes with very short, stiff cilia and a sulcate lamina; peduncle and leaf glossy-red, 6–9 cm. long, in the upper part with a more or less scabrous carina and a rather blunt, 1 mm. long tip. In the rugose leaf-base and the glossy-red peduncle leaf the specimen resembles *X. surinamensis*. It may be it is a hybrid of the latter species with *X. glabrata*.

SURINAM: frequent on wet places with Cyperaceae, rocks, Savanna II, Tafelberg, *24277*. Frequent, wet open places on rocks, Savanna I, Tafelberg, *24203*. A rather common species in Surinam.

XYRIS GUIANENSIS: Steudel. British Guiana: locally frequent, sandy ground, sedge bog, Kaieteur Plateau, *23179*. SURINAM: frequent on cracks in rocks, Lisa Creek near falls, Tafelberg, *24385*. The specimens are comparatively small, 9–14 cm. high and with very narrow leaves, 0.8–1.1 mm. wide. A rather common species in Guiana and Brazil.

Xyris connosepala Lanjouw & Lindeman sp. nov. Species e stirpe *Xyridis guianensis* Steudel. Caespitosa, radicibus tenuissimis. Folia complanata, 3–5 cm. longa, 0.2–0.7 mm. lata, apice acutiusculo, aciebus cartilagineo-incrassatis, in juventute ciliis minimis ornatis; vagina quintam vel quartam partem folii occupanti, ligula 0.4–0.6 mm. longa, acuta ornata, hyalino-marginata, eciliata, superne lamina nonnihil latiori, inferne paulo

dilatata. Scapi teretes, gracillimi, 12–22 cm. alti, ca. 0.25 mm. crassi, laeves, basi folio involuti ceteris longitudine aequante, longevaginata laminaque 7–11 mm. longa. Spica vulgo 2–3-flora, fusiformis, 4.0–5.5 mm. longa, 1.5–2.0 mm. crassa; bracteae infimae ovato-oblongae, ca. 3 mm. longae et 1.2 mm. latae, obtuse carinatae, area dorsali longa ornatae, obtusiusculae, bracteae secundae ovato-oblongae, ca. 3.5 mm. longae, ecarinatae, area dorsali magna, lanceolata, 3 mm. longa ornatae, obtusae, ceterae lanceolatae, naviculares, ca. 4.2 mm. longae, area dorsali 2 mm. longa ornatae, obtusae. Sepala lateralia postice in parte tertia vel quarta inferiore connata, subequilateralia, lanceolata, ca. 4.3 mm. longa, junctim 1.2 mm. lata, in parte media anguste serratulo-carinata, obtusiuscula. Ovarium uniloculare, oblongum, ca. 2 mm. longum, placenta basali-centralis, funiculis longis. Semina fusiformia, 0.5 mm. longa, 0.2 mm. lata, longitudinaliter striata, fusca.

TYPE: Surinam: frequent in wet sphagnum-filled cracks in rocks, Savanna IV, Tafelberg, Aug. 16, 1944, *Maguire 24395a*. Utrecht, New York Botanical Garden.

A remarkable new species related to *X. guianensis* and *X. filiscapa* in its vegetative parts, to *X. subuniflora* in the connate sepals.

XYRIS JUPICAI L. C. Rich. BRITISH GUIANA: locally frequent on rocks by river, Potaro River Gorge, Amatuk Portage, *23023;* locally occasional, aquatic tufted perennial, Kaieteur Plateau, *23235*. SURINAM: frequent in flowing water, Geyskes Creek, Camp No. 5, Coppename River Headwaters, *24833;* in wet sand, savanna vicinity, Sectie O, km. 68, *25013;* wet sand savanna, Zanderij II, *25036*. A very common American species.

ANNONACEAE[112]

UNONOPSIS GUATTERIODES (A.D.C.) R.E.Fr. *Anona peduncularis* Steud. SURINAM: scandent shrub, infrequent, Saramacca River, vicinity Brokolonka, *23793*. British to French Guiana, North Brazil (States of Amazonas, Pará, and Maranhão).

UNONOPSIS GLAUCOPETALA R.E.Fr. SURINAM: tree 7 m. high, 1 dm. in diameter, flowers green, very fragrant, border pina swamp, Saramacca River Headwaters, vicinity of Krappa Camp (No. 2), *24124*. Known also from British Guiana.

CYMBOPETALUM BRASILIENSE (Vell.) Benth. SURINAM: infrequent, Saramacca River, along railroad near km. 70, *23609;* wallaba forest along Tafelberg Creek, vicinity of Base Camp, *24096*. Trinidad, Venezuela, British Guiana, Surinam, Brazil south to Rio de Janeiro.

XYLOPIA AMAZONICA R.E.Fr. SURINAM: tree 5 m. tall, 15 cm. in diameter, bark thin, reddish, longitudinally scaling, buttressed, flowers white, mixed wallaba forest, km. 22, Tafelberg, *24818*. Previously known only from the Amazon region of Brazil (Manáos).

ANAXAGOREA DOLICHOCARPA Sprague & Sandw. SURINAM: small tree, 8 m. high, 10 cm. diam., petals fleshy, brown outside, cream within, primary jungle to rear of village of Posoegronoe, Saramacca River, *24021;* frequent in low dense wallaba forest, Tafelberg Creek, vicinity of Base Camp, *24097;* infrequent, fruit cream-colored, stipe reddish, cauliflorous, southern

[112] By Robert E. Fries.

rocky slopes of Arrowhead Basin, Tafelberg, *24605*. East Colombia and Venezuela, all Guianas, and Brazil south to Bahia and Rio de Janeiro.

GUATTERIA CHRYSOPETALA (Steud.) Miq. *Anona chrysopetala* Steud. SURINAM: frequent, along rim of Arrowhead Basin, Tafelberg, *24430*. The type is known only from Surinam, two varieties from French Guiana and North Brazil (Pará).

GUATTERIA GRACILIPES R.E.Fr. SURINAM: frequent, tree 5 m. high, 5 cm. diam., fruit turning purple-black, receptacle and pedicels red, Tafelberg, 1.5 km. south of East Ridge, *24589*. Previously known only from North Brazil (State of Pará).

GUATTERIA UMBONATA R.E.Fr. BRITISH GUIANA: from bush island in savanna, occasional, Kaieteur Plateau, *23121*. Previously known only from the state Pará of Brazil.

GUATTERIA PROCERA R.E.Fr. SURINAM: tree 12 m. high, 15 cm. diam., flowers greenish, in high mixed forest, Tafelberg, below cliffs of west escarpment, *24684*. Previously known only from Essequibo River in British Guiana.

GUATTERIA SCHOMBURGKIANA Mart. SURINAM: overhanging cliffs, west escarpment, Tafelberg, *24683;* frequent, tree 18 m. high, 25 cm. diam., mixed transition high-low bush, 5 km. s. w. Savanna No. 1, Tafelberg, *24781*. British Guiana, Surinam, and North Brazil.

GUATTERIA SCANDENS Ducke. BRITISH GUIANA: occasional in mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22941*. SURINAM: infrequent; high climbing rope, cauliflorous, flowers yellow-green, anthers orange, fruit red, swampy bush to rear of village of Kwatta hede, Saramacca River, *23916*. British Guiana to French Guiana, State of Pará in North Brazil.

DUGUETIA MEGALOPHYLLA R.E.Fr. BRITISH GUIANA: Takutu Creek to Puruni River, Mazaruni River, ***F2090*** (***F.D. 4826***). The description of this new species, based on the same number, is published this year in Kew Bulletin.

DUGUETIA CALYCINA R.Ben. SURINAM: gorge below Augustus Falls, North Ridge Creek, *24758;* south base of Table Mountain, Tafelberg, *24820*. Guiana and North Brazil (Pará).

DUGUETIA INCONSPICUA Sagot. SURINAM: shrub to 1.5 m. high, flowers white, below cliffs of west escarpment in high mixed forest, Tafelberg, *24685*. British to French Guiana.

DUGUETIA NEGLECTA Sandw. BRITISH GUIANA: Kamuni Creek, Groete Creek, Essequibo River in high mixed forest, *22818; 22899*. Known only from British Guiana.

DUGUETIA PYCNASTERA Sandw. BRITISH GUIANA: infrequent, opening in high forest, Kamuni Creek, Groete Creek, Essequibo River, *22889*. Known also from Surinam.

ANNONA SYMPHYOCARPA Sandw. BRITISH GUIANA: rare, tree 6 m. high, 15 cm. diam., bush island, Kaieteur Plateau, *23443*. Previously known only from Demerara and Essequibo Rivers, British Guiana.

ANNONA HAEMATANTHA Miz. SURINAM: rope, flowers purple, high forest, Arrowhead Basin, base south cliffs, Tafelberg, *24470*. British to French Guiana.

ROLLINIA EXSUCCA (Dun.) A.DC. BRITISH GUIANA: 100 feet high and

2 feet diam., secondary forest on white sand, Potaro River Gorge, trail from Tukeit to Kaieteur Falls, *23065*. West Indies (Trinidad), Venezuela, Guiana and North Brazil (Pará, Amazonas).

MONIMIACEAE[113]

SIPARUNA DECIPIENS A.DC. SURINAM: Saramacca River near Jacob kondre, *23885*. A rather common species.

SIPARUNA SPRUCEI A.DC. SURINAM: lower North Ridge Creek, Tafelberg, *24807*. New for Surinam. A remarkable new record of this rare species, hitherto only known from the Rio Uaupes in the northern Amazonian Brazil.

SIPARUNA GUIANENSIS Aubl. BRITISH GUIANA: frequent in forest, Essequibo River, Kamuni Creek, Groete Creek, *22886*. A very common species.

SIPARUNA sp. BRITISH GUIANA: locally common, small tree with brick red fruit with a strong unpleasant odor, on rocky lateritic soil from dolerite dyke, Potaro River, Garroway stream, *22997*. Material too incomplete for determination. Probably a new species.

DROSERACEAE[114]

DROSERA CAPILLARIS Poir. SURINAM: frequent, in *Sphagnum* along seeps, Savanna VIII, Tafelberg, *24432; 24486*. Southern United States to Guiana.

DROSERA CAYENNENSIS Sagot ex Diels. BRITISH GUIANA: common, leaves red, occasionally green in shade, flowers white, from beneath a bromeliad, savanna, Kaieteur Plateau, *23466*. Amazonian district, French Guiana.

DROSERA PUSILLA H. B. K. SURINAM: leaves bright red, common, wet sand in savanna, Zanderij II, *25035*. Venezuela, British Guiana. The most common *Drosera* species in Surinam.

CONNARACEAE[115]

ROUREA FRUTESCENS Aubl. BRITISH GUIANA: in mora and mixed forest, Essequibo River, Kamuni Creek, Groete Creek, *22910*. This species seems to be common both in French and British Guiana and in Trinidad. It has curiously enough still not yet been recorded for Surinam.

ROUREA SURINAMENSIS Miq. SURINAM: infrequent, river banks below rapids, Saramacca River, vicinity of Jacob kondre, *23832*. A common species in Guiana.

CONNARUS PERROTTETII (D.C.) Planch. SURINAM: Saramacca River, Tafelberg Creek, *24897;* Saramacca River, 3 km. above Boschland, *24041;* infrequent on river banks below rapids, Saramacca River, near Jacob kondre, *23823;* infrequent on river banks below rapids, Saramacca River, near Jacob kondre, *23815*. A common species in Guiana and the neighboring part of Brazil.

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[113] By J. Lanjouw and J. C. Lindeman.

[114] By G. J. H. Amshoff.

[115] By J. Lanjouw and W. van Zeist.

BURSERACEAE[116]

PROTIUM HEPTAPHYLLUM (Aubl.) March. var. BRASILIENSE Engl. SURINAM: vicinity of Arawak village of Mata, *24956*. Northern and eastern South America.

Protium Pullei Swart, sp. nov. Arbor ca. 12 m. alta. Ramuli robusti 4 mm. diam. teretes glabri fusci lenticellis oblongis ferrugineis minutis. Folia trifoliata 17(16–21) cm. longa glabra, petiolis robustis semiteretibus 4–5 cm. longis ad basim incrassatis demum transverse rimosis, petiolulis semiteretibus robustis utrinque subincrassatis 1 cm. longis terminalibus 2.25 cm. longis foliolis oblongo-ellipticis 11(7.5–13) cm. longis 5(3.75–5.5) cm. latis, ad apicem abruptius acuminatis, acumine sublineari 8(5–10) mm. longo 2.5 (2–3) mm. lato, ad basim cuneatis, margine integro coriaceis utrinque nitidis laevibus supra glaucescentibus infra viridibus nervis secundariis utrinque 11 nervis primariis et secundariis utrinque prominentibus. Inflorescentiae axillares breves pauce ramosae pauciflorae ca. 1 cm. longae. Ramuli teretes striati cum pedicellis teretibus flore aequilongis bracteis bracteolisque triangularibus obtusis densiuscule puberuli. Flores 5-meri. Calyx cupuliformis lobis oblongo-triangularibus acutis tubo aequilongis. Petala valvata oblongo-triangularia acuta apiculo inflexo carnosa. Stamina 10. Discus 10-lobus glaber. Pistillum glabrum ovario late ovoideo stigmate 5-lobo coronato.

TYPE: frequent, tree 12 m. high, 15 cm. diameter, exuding a pitch on trunk used by Indians to make fire, mixed transition high-low bush 5 km. s.w. Savanna 1, Tafelberg, Surinam, *Maguire 24784*. New York Botanical Garden.

Protium Pullei Swart closely resembles *P. attenuatum* (Rose) Urb. from the Lesser Antilles and *P. Icicariba* (DC.) March. from s.e. Brazil. It differs from both species by its constantly trifoliolate leaves and in that the acumen of the leaflets is three times as long as wide; moreover it differs from the former species by its clustered and few-flowered inflorescenses and from the latter species by its semiterete robust transversely rimose petioles, its larger leaflets and its glabrous calyx and corolla.

Protium Pullei Swart is named in honor of Prof. Dr. A. A. Pulle, of Utrecht, who devoted his scientific career to the promotion of the research of the flora of Surinam and who recently retired from official duty.

PROTIUM TRIFOLIOLATUM Engl. BRITISH GUIANA: Kaieteur Plateau, along Potaro River above Kaieteur Falls, *23533*. Equatorial South America, east of the Andes.

TRATTINICKIA BURSERIFOLIA Mart. BRITISH GUIANA: bush island, Kaieteur Plateau, *23209*. SURINAM: Saramacca River, trail to rear of village of Pakka Pakka, *23970A;* opening in rocky area, low Clusia-bush, between Camps no. 2 and 1, Tafelberg, *24641*. Equatorial South America, east of the Andes.

MELIACEAE[117]

TRICHILIA SUBSESSILIFOLIA C. DC. SURINAM: tree 12 m. high, 15 cm. in diameter, flowers white, low forest, frequent, Tafelberg, *24195;* tree 15 m.

[116] By J. J. Swart.

[117] By G. J. H. Amshoff.

high, 20 cm. in diameter, flowers white, on line, vicinity Blackwater Camp (5), Coppenam River Headwaters, *24182* fl. July. French Guiana and Surinam; represented in British Guiana by the very closely allied (perhaps not specifically distinct) *T. Schomburgkiana* C. DC.

TRICHILIA ACARIAEANTHA Harms. SURINAM: small tree, fruit turning yellow, inner pericarp bright red, high bush, base north escarpment, Tafelberg, *24182*. Surinam (collected in the forest reserves Sectie O, Zanderij I and Brownsberg) and British Guiana (Essequibo River region, *F. D. 2478* and *4023*).

ERYTHROXYLACEAE[118]

ERYTHROXYLUM CITRIFOLIUM St.-Hil. SURINAM: shrub or small tree, flowers greenish, savanna vicinity Sectie O, km. 68, *25023*. Central America, northern South America. Probably throughout the country.

VOCHYSIACEAE[119]

QUALEA ALBIFLORA Warm. SURINAM: tree 25 m. tall, 50 cm. in diameter, petals white with a yellow central line, high mixed wallaba forest, base of talus, Tafelberg, *24841*. Guiana, Amazonian district.

VOCHYSIA TETRAPHYLLA (G. F. W. Meyer) DC. SURINAM: tree, flowers yellow, overhanging Toekoemoetoe Creek, *24917*. Frequent throughout Guiana, along rivers.

AQUIFOLIACEAE

ILEX JENMANII Loes. SURINAM: tree 10 m. high, vicinity Arawak village Mata, Zanderij I, *24954*. British Guiana. Collected in Surinam in the forest reserves Zanderij I and Sectie O, and along the Coppenam River.

OCHNACEAE

ELVASIA ESSEQUIBENSIS Engl. BRITISH GUIANA: tree 12 m. tall, 12 cm. diam., common, mixed forest, Kamuni Creek, Groete Creek, Essequibo River, *22934*. Apparently restricted to British Guiana.

POECILANDRA RETUSA Tul. BRITISH GUIANA: tree 4 m. high, 4 cm. diam., flowers yellow, occasional Kaieteur Savanna, *23186; 23186a*. Generally distributed in the Guiana Highland of Venezuela and British Guiana.

Ouratea decagyna Maguire, sp. nov. *O. polygyna* sensu Wehlburg, Fl. Surinam **3**: 335. 1937; non Engler, Fl. Bras **12**[2]: 342. 1876. Arbor mediocris; laminis ellipticis vel oblongo-ellipticis, apicibus brevi-acuminatis, subconduplicatis, basibus subacutis vel obtusis, marginibus obsolete serrulatis; paniculis late pyramidalibus, dense floriferis; alabastris ovoideis magnis; floribus magnis, carpidiis 10; receptaculis disciformibus; drupis late ellipsoidalibus.

Medium-sized non-buttressed tree with smooth bark and hard red wood; leaf blades (4) 5–7 cm. broad, (8) 10–18 cm. long, elliptic to oblong-elliptic, the apex short-acuminate, subconduplicate, the base subacute or obtuse, the margins obsoletely serrulate, lateral veins numerous, indistinct, the primary about 10 (pairs), arcuate, midrib prominent, petioles 8–10 mm. long; panicle 8–15 cm. long, broadly pyramidal, densely flowered; buds ovoid 8–10 mm.

[118] By G. J. H. Amshoff.

[119] By F. A. Stafleu.

long, 4-5 mm. broad; flowers yellow, fragrant; sepals 10–12 mm. long, 5–6 mm. broad, lanceolate; petals 14–16 mm. long, 10–12 mm. broad, obovate-spatulate; anthers 10, sessile, 9–10 mm. long, ca. 1.5 mm. wide at the base, tapering to a beak 0.5 mm. wide, transversely rugose; carpids 10; style 9–11 mm. long, contorted; receptacle fleshy, disciform, red, its symmetry dependent upon the number of carpids developing; drupes 6–8 mm. long, broadly ellipsoid, purple.

TYPE: tree 20 m. tall, 3 dm. diam. not buttressed, bark smooth, wood red, hard, flowers yellow, fragrant, mixed montane forest, km. 4, Saramacca River Headwaters, July 17, 1944, *Maguire 24128*. New York Botanical Garden. Cotypes: tree 20 m. high, 40 cm. diam., leaves dark green, flowers yellow, mixed high montane forest, North Ridge, Tafelberg, *Maguire 24805;* tree 25 m. tall, 4 dm. diam., flowers yellow, fragrant, receptacle red, fruit purple, frequent, mixed Wallaba forest, km. 19, Coppenam River Headwaters, Sept. 23, 1944, *Maguire 24835*. In addition to the type collections, apparently *B.W. 6880*, Brownsberg, Surinam, cited under *O. polygyna* in the Fl. Surinam (l.c.), belongs here. Unquestionably this species is closely allied to *O. polygyna* of Bahia, Brazil, because of the ten-carpellate ovary common to both. No specimen of *O. polygyna* has been seen. A comparison of our new species with it must therefore be drawn from Engler's[120] detailed original description and plate.

	O. polygyna	*O. decagyna*
leaves	2.5–3.5 × 10–15 cm. ratio approx. 1 : 4	(4) 5–7 × 8–18 cm. ratio approx. 1 : 2.4
bud	4–5 mm. long	8–10 mm. long
sepals	5 mm. long	10–12 mm. long
petals	5–6 mm. long	14–16 mm. long
anthers	4 mm. long	7–10 mm. long
style	4 mm. long	12 mm. long

A consideration of these figures forces the conclusion that the Surinam plants are specifically distinct, for the discrepancy in flower size is clearly much beyond the tolerable range of species variation in *Ouratea*. And not only is the leaf of *O. decagyna* relatively twice as broad as that of *O. polygyna* but it is definitely of a different shape, broadly elliptic to elliptic-oblong as against dedidedly lanceolate, as inspection of plate 69 (op. cit.) clearly shows.

Ouratea Gillyana (Dwyer) Sandwith & Maguire, comb. nov. *Kaieteuria Gillyana* Dwyer, Bull. Torrey Club **70**: 51. Ja 1943; *Ouratea cernuiflora* Sandwith, Jour. Arnold Arb. **24**: 225. Ap 1943. BRITISH GUIANA: shrub 1.5–2.0 m. high, inflorescence, calyx, and fleshy globose receptacle crimson, carpids globose, pale brown, finely tuberculate, 1–5 developing, frequent on bush islands, Kaieteur Savanna, *23172*.

Dwyer, in the January issue of Bulletin of the Torrey Botanical Club (l.c.), proposed the genus *Kaieteuria* based on *Jenman 863* from Kaieteur as distinct from *Ouratea* because of "striking" flower and fruit differences, viz. (1) that the calyx consists of 2 or 3 sepals which are fused in bud, and are "torn apart" during anthesis, and (2) that, "In fruit, the torus

[120] Fl. Bras. **12**[2]: 342, *pl. 69*. 1876.

becomes lignose, scarcely expands and bears a single drupe encased in the two persistent sepals."

Likewise based upon the same collection, *Jenman 863* (and *Jenman 1210*), Sandwith, little more than three months later (Jour. Arnold Arb. l.c.) proposed a new species under the genus *Ouratea* as *O. cernuiflora*.

It is obvious then that whichever may be the proper generic assignment of this species, the specific epithet *Gillyana* takes precedence.

The calyx character of the Kaieteur shrub is indeed striking, but is one that is not completely anomalous in the genus *Ouratea*, as was previously pointed out by Sandwith, who wrote of it (p. 226, l.c.): "An outstanding species of *Ouratea* on account of the ascending axillary [or terminal] racemes with nodding flowers on recurved pedicels and the very peculiar calyx with completely fused and indistinguishable sepals ruptured at the time of flowering into 2 or 3 concave coriaceous lobes. A tendency to a gradation toward this phenomenon can be observed in certain other species, for instance, on some specimens of *O. acuminata* (DC.) Engl. in which the inner sepals adhere so closely to the coriaceous outer members that their broadly scarious free margin cannot be separated and distinguished without dissection and examination of the inner side of the whole calyx." It may be further observed that this "rupturing" or "splitting" is not an irregular parting of the tissues as a result of pressure from within, but a regular dehiscence along the connate margins of the sepals.

The other differences cited by Dwyer, as is now evident from field observation and further collected material, do not obtain. Persistent sepals commonly occur in a number of species of *Ouratea*. At maturity the receptacle of this species under question is fleshy, and may be expanded to as much as 5 mm. in diameter. Commonly a single drupe does mature, as stated by Dwyer, but a single developed carpid is of common occurence among many species of *Ouratea*. However, frequently in specimens of the Kaieteur species several or often 5 carpids mature, exhibiting a variability in this regard that is generally found in the genus.

As a consequence, in review of the problem, Mr. Sandwith adheres to his earlier assignment of this species to the genus *Ouratea*. I concur in this disposition; accordingly we join in the necessary transfer of *Kaieteuria Gillyana* to *Ouratea Gillyana*.

OURATEA GUIANENSIS Aubl. BRITISH GUIANA: shrub to 2 m. high, branches few, horizontal, flowers yellow, mature fruit black, receptacle swollen, yellowish, on white sand, mixed forest, Kangaruma, Potaro River, *22993*. SURINAM: small tree, petals pale yellow, anthers deep yellow, Tafelberg Creek, Saramacca River Headwaters, *24085;;* shrub or small tree, flowers yellow, vicinity Blackwater Camp, (5) Coppenam River Headwaters, *24171*. British Guiana to Amazonian Brazil.

Additional collections from British Guiana are to be referred here: Potaro River, *Gleason 125*, *224*, *227*, *245*, *246*, and *248;* Mazaruni River, *Leng 238;* on all of these sheets Mr. N. E. Brown made the following annotation "= *Jenman 1100*, from Waraputa cataract." On *Gleason 125* Brown further wrote: "This *Ouratea* is very much like Aublet's type of *O. guianensis*, with which I have this day compared it, but it differs from that species by its leaves being more cuneate at the base, the veins rather

more numerous, and the inflorescence rather less branched. N. E. Brown Feb. 28, 1923."

Surinam material is variable, the leaves attaining dimensions of 13–45 cm., with decidedly finely serrate margins. These conditions would seem to bridge the gap between *O. guianensis* as interpreted here and the Brazilian *O. gigantophylla*. But leaves of the Brazilian species have deeply and conspicuously impressed veins, and stand very distinctly apart from those of *O. guianensis*. Even so certain specimens of the latter from British Guiana, notably *Gleason 227*, and *248* from the Potaro River have more than a suggestion of the impressed vein character. The Guiana plants seem to be even closer to *O. tarapotensis* Macbr. of the Amazonian Peru.

Mr. Sandwith has suspected (in correspondence of Aug. 5, 1948) that the British Guiana material, at least, may be referable to *O. longifolia* (DC.) Engl., but he has not had the opportunity to examine the type of that binomial nor that of *O. guianensis*.

A better understanding and more adequate material of these populations my demonstrate them to constitute a single widespread and polymorphic species. Moreover, adequate typification is necessary before any of the specimens here cited may be definitely assigned.

OURATEA SCHOMBURGKII (Planch.) Engl. BRITISH GUIANA: shrub 10 feet high, Iteballi Falls, Essequibo River, *F 1669* (*F.D. 4405*); shrub to 20 feet high, 6 inches diam., rocky island, Marshall Falls, Mazaruni River *F2689* (*F.D. 5482*); tree 20 feet high, 3 inches diam; Ituribisi Lake, Essequibo coast, *F2697* (*F.D. 5472*). SURINAM: tree, torus red, river bank, Saramacca River between Jacob kondre and Kwatta hede, *23901;* shrub or small tree, floral axis and torus red, fruit black, full exposure, small open island, Saramacca River between Kwatta hede and Pakka Pakka, *23954*. Amazonian Brazil, Surinam, British Guiana.

Mr. Sandwith has examined *F.D. 4405*, and *23954*, of which he writes; "*F.D. 4405* [is] in my opinion certainly *O. Schomburgkii* (Planch.) Engl. We have authentic material and several other sheets. Surely *Maguire 23954* is also probably *I. Schomburkii!* The leaves and inflorescence match extremely well. We have type-number material of Ule's *O. racemiformis* [to which I had referred the specimens in question], *Ule 7991*, and I have identified it in the past as *O. Schomburgkii;* and see no reason to alter my opinion."

In acknowledgement of Mr. Sandwith's judgement the specimens cited above are referred to *O. Schomburgkii*. In the same light it would seem also that *O. racemiformis* must become a synonym of *O. Schomburgkii*.

OURATEA cf. O. *roraimae* Engl. BRITISH GUIANA: shrubs 2 m. high, 1–2 cm. diam., flowers yellow, fruit (immature) green, torus crimson, occasional sedge bogs and bush-island fringes, Kaieteur Savanna, *23147; 23147a; 23147b;* shrub of scrub savanna, to 6 feet high, on white sand, Ituni Road, Mackenzie, Demerara River, *F2495* (*F.D. 5231*). Savannas, British Guiana and southern Venezuela.

OURATEA SURINAMENSIS (Planch.) Wehlburg. SURINAM: shrub to 2 m. high, bark grayish-brown or brown, tending to exfoliate, flowers yellow, torus dark red, carpids grayish, minutely rugulose, frequent, Savanna II, Tafelberg, *24249;* Savanna IV, Tafelberg, *24389a, 26175*. Known only from Surinam.

SAUVAGESIA ERECTA L. BRITISH GUIANA: perennial herb to 30 cm. high, Garraway Stream, Potaro River, *22792*. SURINAM: frequent annual, Charlesburg Rift, 3 km. north Paramaribo, *22744;* annual or short-lived perennial, stony stream side, Blackwater Camp (5) Coppenam River Headwaters, *24190;* perennial herb, petals pale pink, stamens and stamenodes red, mossy banks, lower Augustus Creek, Tafelberg, *24733*. Widespread, West Indies and tropical America; reportedly pantropic.

SAUVAGESIA RORAIMENSIS Ule. SURINAM: annual, flowers white, base dripping cliffs, north escarpment, Tafelberg, *24193;* annual, flowers white, dry opening in low bush 1.5 km. south of Savanna I, Tafelberg, *24352;* annual, flowers white, openings in high bush vicinity Arrowhead Basin, Tafelberg, *24418*. Mt. Roraima, Venezuela (type locality), and Surinam. Otherwise reported in Surinam from Hendriktop and the Wilhelmina Range.

Our specimens are all definitely annual. The other material from Surinam is described as underbrush, 30–50 cm. high, and the type as "suffruticosa," the "stengel 3–5 dm. hoch." Nevertheless, in consideration of the extreme variability in habit that occurs elsewhere in the genus, the Tafelberg plants must be interpreted as *S. roraimensis*.

SAUVAGESIA SPRENGELII St.-Hil. BRITISH GUIANA: perennial suffrutescent herb, stems red, flowers pink, frequent, dry sandy soil, Kaieteur Savanna, *23202* (intermediate to *S. amoena* Ule). Surinam: flowers rose, frequent on white sand, Zanderij II, *23693;* perennial, petals white flushed with pink, frequent, Savanna I, Tafelberg, *24208*. Widespread, Trinidad and tropical South America.

The Kaieteur specimens are intermediate in habit and leaf character between the exceedingly polymorphic *S. Sprengelii*, and the geographically restricted *S. amoena*, suggesting that the latter may be only an extreme broad-leafed phase of *S. Sprengelii*.

CARYOCARACEAE

ANTHODISCUS MAZARUNENSIS Gilly. SURINAM: tree 25 m. high, 50 cm. diam., flowers yellow, corolla calyptroid, high bush, south rim Arrowhead basin, *24576*.

COMBRETACEAE

Buchenavia Fanshawei Exell & Maguire, sp. nov. Arbor mediocris; folia breviter petiolata, petiolo sparsissime minute pubescenti vel glabro; lamina oblanceolata apice breviter acuminato, basi acuto, glabra, haud conspicue lepidota, costis infra prominentibus; fructus sessilis oblongo-globosus, carnosus, juventute dense pubescens demum glabrescens.

Tree probably as much as 35 m. high and 50 cm. diam; leaves short-petioled, the petioles sparsely and minutely pubescent or glabrous, the blades 7–14 cm. long, (2.5) 3.5–6.0 cm. broad oblanceolate, the apex with a short blunt acumen, the base acute, glabrous not at all lepidote, the lateral veins 3–4 pairs, impressed in the upper surface, prominent on the lower; spikes axillary, 3–6 (12) cm. long, angled, pendant, tawny-pubescent, finally glabrescent; flowers not present in the type collection; drupes oblong-globose, 15–18 mm. long, fleshy, yellow, sparsely hirtellous, glabrate, 1–3

maturing; seed 12–15 mm. long, strongly ribbed lengthwise, pale cream, embedded in a transluscent mucilage.

TYPE: tree 10 m. high, 40 cm. diam., fruit oblong-globose, yellow, in pendant spikes, seed solitary, pale cream, embedded in transluscent mucilage; rare, riverside, Potaro River below Tukeit, British Guiana, May 16, 1944, *Maguire & Fanshawe 23499*. New York Botanical Garden; British Museum.

BRITISH GUIANA: tree 40 feet high, berry yellow, banks of Potaro River, Tumatumari, *Gleason 401*. In addition, almost certainly the following belong here: tree 12 m. high along river, Kuyuwini River, *Smith 3033;* from large relict tree in secondary forest, Mazaruni Station, towards Labbakabra Creek, *Sandwith 1219;* Kamakusa, upper Mazaruni River *la Cruz 3074;* tree 90 feet high, 16 inches diam. Mahdia River, Potaro River, Bartica-Potaro Road, *F1039* (*F.D. 3775*); tree 110 feet high, 20 inches diam., same locality, *F1064* (*F.D. 3800*).

The only flowering specimen at hand should be commented on more at length: tree 60 feet high, 10 inches diam., from secondary forest on brown sand; leaves young, when mature leathery, stiff, margins revolute, tufted at branch ends, flowers in axillary spikes, yellow-green, perianth shaped like a flat bowl, barely lobed, Mazaruni Station, *F1270* (*F.D. 4006*). The characterization of flowers of *F1270* is in all probability to be considered a part of the description of *B. Fanshawei:* flowers apetatous; patelliform, 3–4 mm. in diam. the low margins incurved, with about 10 inconspicuous lobes; stamens 10, inserted at three levels on the calyx tube, near the margin, at an approximately mid-way point, and near the base, the filaments ca. 2 mm. long, anthers elliptic, ca. 1 mm. long, introrse, substipitate, separated by a broad, deltoid connective; ovary broadly disciform-conic, densely tawny-tomentose, style ca. 1 mm. long, awl-shaped.

This species is characterized by its oblanceolate leaves with only 3–4 pairs of lateral nerves which are rather prominent on the lower surface, and join the midrib at an acute angle. In these characters it is closest to *B. ochroprumna* Eichl., which has however, smaller, more obovate leaves and fruit which retain a dense indumentum when mature. *B. grandis* Ducke has glabrous fruit similar to those of *B. Fanshawei*, but somewhat larger, and leaves of approximately the same size but with 6–7 pairs of nerves and a much closer reticulation.

COMBRETUM BRUNNESCENS Gleason. BRITISH GUIANA: vine, fruit green, occasional, Kaieteur Savanna, *23355*.

COMBRETUM CACOUCIA (Baill.) Excell. SURINAM: liana, sepals and petals green, tinged with pink, filaments red, along railway Sectie O, km. 70, *23623; 23642*. Widespread in tropical America.

COMBRETUM PYRAMIDATUM Desv. SURINAM: shrub or small tree 3 m. high, flowers white, infrequent, river banks below rapids, Jacob kondre, Saramacca River, *23809*.

COMBRETUM LAXUM Jacq. SURINAM: vine, flowers white, frequent Toekoemoetoe creek, Saramacca River, *24067*.

Terminalia quintalata Maguire, sp. nov. Arbor mediocris; foliis oblongo-obovatis vel oblanceolatis, subcoriaceis glabris, integris, petiolis brevibus, alato-marginatis; inflorescentiis spicatis, axillaribus; floribus sessilibus,

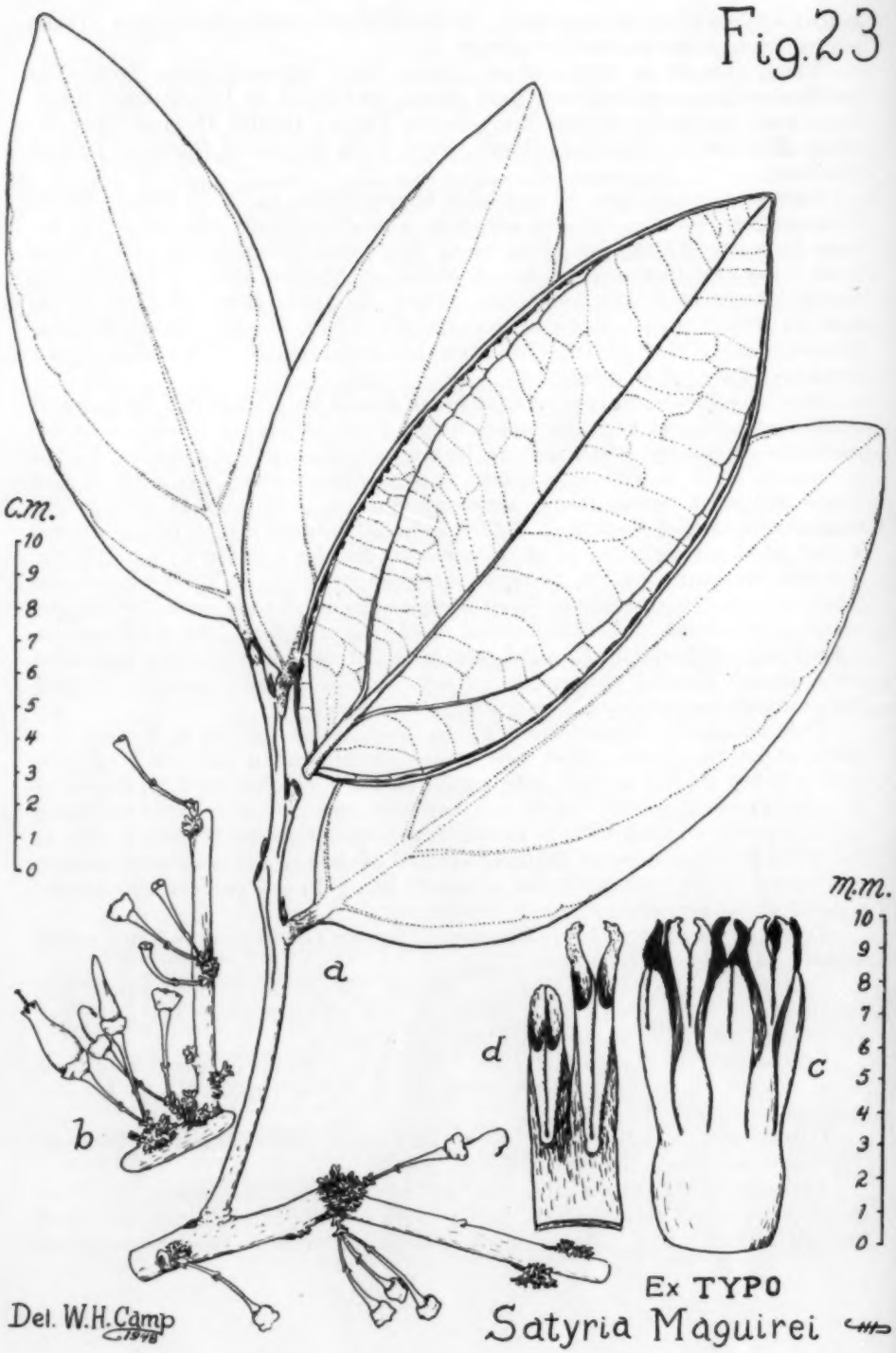
Fig. 23
c.m.
10
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8
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a
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d
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m.m.
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7
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2
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Del. W.H. Camp 1918
Ex TYPO
Satyria Maguirei

filamentis vix exsertis; fructubus parvis, late oblongo-ellipticis, aequaliter quinque-alatis.

Tree at least 25 m. high, 50 cm. diam.; leaves aggregated near the ends of the shoots, wing-petioled or the upper most subsessile, petioles to 1.5 cm. long, blade 10–15 cm. long (those subtending the inflorescences as little as 3 cm. long and 1.5 cm. broad), 5–9 cm. broad, oblong-obovate to oblanceolate, the apex rounded or obtuse, the base narrowed to the winged petiole, strongly chartaceous to subcoriaceous, glabrous, the veins inconspicuous on the upper surface, somewhat prominent on the lower; inflorescences axillary, spicate, 10–15 cm. long, minutely puberulent; flowers pentamerous, ovary densely tan-short-villous, the hypanthium goblet-shaped, 2.0–3.0 mm. long, puberulent, thinly pilose within, the fornices densely pilose, the 5 lobes ovate, acute, 1.0–1.75 mm. long; stamens 10, filaments white, awl-shaped, exserted by 1 mm. or less, anthers ca. 1 mm. long, apiculate, deeply cordate, versatile; style 3–4 mm. long awl-formed, ovules 2, pendant; fruit inclusive of wings 8–10 mm. long, about 8 mm. thick, the broadly oblong-elliptic wings equal, about 2 mm. wide.

TYPE: tree 24 m. high, 45 cm. diam., fruit winged, carmine, on erect spikes, locally frequent, Potaro River Gorge, below Amatuk Portage, British Guiana, May 19, 1944, *Maguire & Fanshawe 23551*. New York Botanical Garden. Cotype: tree 20 m. high, 25 cm. diam., buds white, locally frequent, forming pure clumps, low bush, vegetative branchlets coarse, ashy-gray, the flowering branchlet slender, Kaieteur Plateau, *23459*. The following sterile collection was likewise made on the Kaieteur Plateau: tree 5 m. high, Kaieteur Savanna, *23313*. Known only from the type region.

T. quintalata seems to be most closely related to *T. amazonia* (J. F. Gmel.) Exell [*T. obovata* (R. & P.) Steud.], but differs strongly in leaf, flower, and fruit characters. Its fruit is similar to that of *T. Oliveri* Brandis of Burma, but is only half as large.

ERICACEAE[121]

BEFARIA GLAUCA H.B.K. BRITISH GUIANA: Kaieteur Savanna, *23268*. As noted elsewhere, there seems little point in attempting to affix the varietal names recognized by others in this widespread and variable species since they seem to have little or no geographic correlation.

VACCINIACEAE[122]

NOTOPORA SCHOMBURGKII Hook. f. BRITISH GUIANA: Kaieteur Plateau, *23145*, *23150*. These collections are from within the known general range of the species, this being British Guiana (primarily the Kaieteur Plateau) and parts of Brazil adjacent Mt. Roraima. A specimen from Auyán-tepui, Vene-

[121] By W. H. Camp.

[122] By W. H. Camp.

Explanation of figure 23

Satyria Maguirei Camp, sp. nov. From the type sheet, *Maguire 24474*, Herb. N. Y. Bot. Gard. a. Branch, one leaf removed and reversed, showing lower surface. b. Detached portion of old stem and branch. c. Stamens, with fused filaments and alternate five long and five short anthers. d. Adaxial view of a pair of anthers.

zuela, *Felix Cardona 257*, said to be this species, may be distinct. The differences between the present collections, noted on the tickets, seem to fall within the range of variability of this species as I understand it.

ORTHAEA APOPHYSATA (Griseb.) A. C. Smith. BRITISH GUIANA: Amatuk Portage, Potaro River, *23026;* Kaieteur Plateau, *23154*. Recorded as being a "rope" or liana. Up to about a decade ago this species was known only from the island of Trinidad, B.W.I.; in addition to the foregoing, there is before me a specimen (*Sandwith 1252*) collected at "Amatuk, Potaro River" in 1937, apparently from the same locality as one of these.

Satyria Maguirei Camp, sp. nov. Frutex scandens. Petiolus ad 15 mm. longus. Folia elliptica vel subovata, apice obtusa vel subacuta, basi rotundato, 12–22 cm. longa, 6–11 cm. lata, coriacea, subnitida, margine integra revoluta, 5-plinervia. Inflorescentia cauliflora, 1–6-flora, 5 mm. longa. Flores consimiles descriptioni et illustrationi *Satyriae carnosiflorae* Lanjouw (Rec. Trav. Bot. Néerl. **30**: 165–167, *f.lc-f.* 1933).

TYPE: Surinam: "frequent, flowers red; intermediate forest, south rim Arrowhead Basin," 725 m. Aug. 24, 1944, Tafelberg; *Maguire 24474*. New York Botanical Garden. Additional specimen; ibid. *Maguire 24429*, Aug. 21, 1944.

This material presents something of a problem. Upon dissection the flowers and flower parts proved to be so similar to the description and figures by Lanjouw for his *S. carnosiflora* that they might easily have been prepared from this material. On the other hand, his description and figures also indicate a plant with fairly long-acuminate leaf apices and axillary inflorescences up to 9 cm. long. The difference in leaf shapes of that material and this perhaps might not warrant the recognition of different species, but the difference in inflorescences is quite marked. Of the ten branch apices available to me for study in the type and additional collection, not a single one bears any evidence of axillary inflorescences. Instead, all of the various available inflorescences are cauliflorous; although morphologically in an axillary position, they seem to appear only after the attendant leaf has fallen, and on wood of the previous season or older. As is not infrequent in the cauliflorous Vacciniaceae, the individual inflorescences may increase in number at any given node until, on the old wood, they appear to form a cluster often associated with the massed bracts of previous inflorescences.

It is, of course, well known that certain of the lianoid Vacciniaceae bear flowers in ordinary axillary inflorescences and also on the old wood; this is even true of certain species of *Satyria*. However, in the great majority of instances where this is known to me there is a marked similarity between the inflorescences in the leaf axils on the new wood and those from the cauliflorous clusters on old wood. In the present instance the loose-flowered racemes of *S. carnosiflora* are said to reach 9 centimeters in length; in the cauliflorous, usually few-flowered inflorescences of the one here described, the longest rachis I could discover was only 5 millimeters long.

A somewhat similar situation is presented in succeeding paragraphs on *Vaccinium subcrenulatum* from British Guiana; however, in that instance the British Guiana Highlands (in connection with the associated areas in Venezuela) are the meeting place of several groups of related species, some of which have terminal and others axillary inflorescences, the latter of these being either long or short. The result is a genetic com-

plex exhibited in the variable inflorescences, apparently on the same plant, of the material from the Kaieteur Plateau. No such pool of species of *Satyria* is known from the highlands of Surinam capable of producing a similar genetic complex.

There are several possibilities; either two species of *Satyria* are present with similar flowers and dissimilar inflorescences and leaves (a common situation in the Vacciniaceae), or *S. carnosiflora* has considerably more variability in inflorescence and leaf characters than one usually thinks of in species of this genus. Also, it is not beyond the bounds of possibility that *S. carnosiflora* might have been based on a mixed collection.

SPHYROSPERMUM MAJUS Griseb. SURINAM: vicinity of Savanna VIII, 2 km. west of East Ridge, 786 m. alt., Tafelberg, *24565*. This appears to be one of the commoner species of the genus, being known from Guatemala and the West Indies southward into the Andes and Guiana Highlands.

THIBAUDIA NUTANS Kl. SURINAM: Tafelberg, *24268; 24473*. The tickets list this as a [bush] "rope," or liana. The Type (*Schomburgk 873*) is from Mt. Roraima and additional previous collections known to me which I would place here are *Pinkus 149*, also from Roraima, and *Holt & Blake 499* from Serra Imeri, Brazilian-Venezuela Boundary. Material reported as this from Auyán-tepui, Venezuela, is related but does not seem to be exactly equivalent.

THIBAUDIA ULEI (Mansf.) A. C. Smith. BRITISH GUIANA: Kaieteur Plateau, *23153*. Described on the ticket as a [bush] "rope." *Sandwith 1336*, from the Kaieteur Savannah, is from a "low pendant shrub." It is suspected that this plant is not a true climbing liana, or "bush rope," but a semi-scandent shrub. At higher elevations, material apparently of this species is lower-growing and more shrubby. This same change in habit among the Vacciniaceae has been noted by me in the field in Amazonian Ecuador; there on the eastern Andean escarpment at low elevations the plants of certain species sometimes are scrambling or long-pendant epiphytes, at the higher elevations they may be quite typical shrubs, sometimes less than a meter tall and growing on soil.

The type of *T. Ulei* (*Ule 40*) is from Mt. Roraima. The species has been previously collected on the Kaieteur Savanna; it also is known from Auyán-tepui in Venezuela. The least satisfactory material of *T. Ulei* and the foregoing (*T. nutans*) comes from Mt. Roraima. The material of *T. Ulei* from the Kaieteur Plateau (and Savanna) appears to be consistent and completely distinct from the currently reported material of *T. nutans* from Surinam. Taken as a group, the material known to me from Roraima appears to partake considerably of varying proportions of the genetic elements of these last two forms. The nomenclatural types of these two came from Roraima and, although different in appearance, also appear to be parts of what might be called the "Tepuia-complex" of this genus, which extends westward from Roraima onto Auyán-tepuia in Venezuela. The morphologically distinct (and biotypical) forms appear to be these from the Kaieteur Plateau in Britsh Guiana and Tafelberg in Surinam. In the present state of our disknowledge of the cytogenetics of these populations there would seem to be little point in nomenclaturally spliting this complex further on the basis of the available evidence. Some specimens have the appearance of hybrids and back-crosses; other related materials with coarse

leaves and larger flowers have much the appearance of polyploids. There is no reason to suspect that hybrid swarms and polyploids are biological phenomena limited to the North American segment of the Vacciniaceae (Camp, Brittonia **5**: 203–275. 1945; etc.).

VACCINIUM SUBCRENULATUM Kl. BRITISH GUIANA: Kaieteur Plateau, *23167; 23385.* Of these two collections, the inflorescences of *23167* are axillary racemes, the shorter (ca. 3–7 cm. long) with minute bracts, the longer (up to 16 cm. long) with large leafy bracts as much as 20 mm. long and 7 mm. wide, these measurements being taken from material sufficient for 4 or 5 full herbarium sheets. I have split the material of *23385*, also sufficient for 4 or 5 sheets, into three parts for ease of reference, *23385a* has axillary racemes, these sometimes leafy, up to 6 cm. long; *23385b* has minute-bracted axillary racemes, the longest of which is 2.5 cm. long. *23385c* has a terminal minute-bracted, paniculate inflorescence (somewhat damaged in shipping); the main axis extends 10 cm. above the uppermost reduced leaves (the terminal portion obviously immature and not fully elongated); the lateral inflorescence branch preserved is 6 cm. long (also not fully developed). The leaves of *23385c* are crowded and appear to be diseased; the stem also appears to be unhealthy. *Pinkus 26*, from the upper Mazaruni River, and *Sandwith 1341* serve to fill in the gaps in the normal spread of variability of this typically Kaieteur Plateau species. The terminal inflorescence of *23385c*, which may be a pathological reversion, at least serves to indicate something of the relationship between the variable *V. subcrenulatum* Kl. and the more recently described *V. spathulatum* Camp & Smith and *V. tepuiense* Camp & Smith, both from Auyán-tepuia, Venezuela, which also seem to have both terminal and axillary inflorescences.

EBENACEAE[123]

DIOSPYROS DICHROA Sandwith. BRITISH GUIANA: tree 110 feet high, 20 in. diam., leaves fawn below when young, silvery when old, velvety-hairy, calyx stiff and fleshy, ovary hairy, fruit globose, hairy. Mahdia River, Potaro River, Bartica–Potaro Road, *F1016* (*F.D. 3752*).

DIOSPYROS GUIANENSIS (Aubl.) Gürke. BRITISH GUIANA: Essequibo River by Yakaramaro Creek, *F1347* (*F.D. 4083*). SURINAM: tree 15 m. high, 20 cm. diam., frequent on river banks above village of Kwatta hede, Saramacca River, *23931*.

DIOSPYROS LISSOCARPOIDES Sandwith. BRITISH GUIANA: tree 25 feet high, flattened stem, fruit axillary, solitary, calyx enlarged, stiff, Bartica Point, Mazaruni-Essequibo junction. *F1190* (*F.D. 3926*); Kauria Cree, lower Cuyuni River, *F1429* (*F.D. 4165*).

DIOSPYROS IERENSIS Britton. BRITISH GUIANA: tree 90 feet high, 16 inches diam., corolla tubular, whitish, fleshy, White Creek, Groete Creek, Essequibo River, *F1784* (*F.D. 4520*); 107 m. Bartica-Potaro Road, *F1500* (*F.D. 4236*).

DIOSPYROS TETRANDRA Hiern. Tree 10 m. high, 15 cm. diam., wood sap turning yellow, flowers white, mixed high forest, vicinity of Augustus Falls, Tafelberg, *24742*. Identified by G. J. H. Amshoff. In Surinam hitherto only collected in the forest reserve, Brownsberg.

[123] By N. Y. Sandwith.

STYRACACEAE

STYRAX GUIANENSIS A. DC. SURINAM: small tree overhanging Lisa Creek, 300 m. above falls, Tafelberg, *24369;* frequent, tree to 15 m., 15 cm. diam., flowers white, leaves silvery beneath, rim of Arrowhead Basin, Tafelberg, *24416; 24424.* British Guiana, Amazonian district. First collection in Surinam. In the Tafelberg specimens, the leaves are smaller than in the typical form.

DICHAPETALACEAE[124]

TAPIRA GUIANENSIS Aubl. SURINAM: infrequent, tree to 3 m., 3 cm. diam., flowers greenish, on petioles, along railroad near km. 70, *23621.* Guiana, Amazonian district. Frequent throughout Surinam.

DICHAPETALUM PEDUNCULATUM (DC.) Baill. SURINAM: rope, fruit light tan, in trees overhanging stream, North Ridge Cascade, Tafelberg, *24669.* Guiana, Amazonian district. Throughout Surinam.

DICHAPETALUM VESTITUM (Benth.) Baill. SURINAM: rope, fruit velvety-brown, on tree overhanging stream, North Ridge Cascade, mixed high forest, Tafelberg, *24658.* Guiana, Amazonian district.

SOLANACEAE[125]

LYCIANTHES sp. BRITISH GUIANA: occasional, vine, flowers green, calyx lobes revolute, fruit scarlet, globose, 2 cm. in diam., on red loam, rocky ground, secondary forest, Potaro River Gorge, *23058.*

SOLANUM SCANDENS L. SURINAM: locally frequent, perennial herb, flowers pink, opening, base north escarpment, mixed high forest, Tafelberg, *23774.* This interpretation of *S. scandens* L. was given by Bitter, who in 1923 determined our Surinam specimens of *Solanum* L. I do not know whether Bitter examined the type, but though the description of Linnaeus in 1775 is very short, the more detailed description given by Linnaeus fil. in 1781 leaves no doubt about the correctness of Bitter's interpretation. Guiana, Brazil.

SOLANUM SCANDENS var. **laetum** (Miq.) Bitter, comb. nov. *Solanum laetum* Miquel, Stirp. Sur. Sel. 135. 1851; non *S. laetum* Kunze, 1842; *Solanum sempervirens* Dunal; DC. Prodr. **13**: 88. 1852; non *S. sempervirens* Mill. 1768. SURINAM: flowers purple, fragrant, anthers yellow, riverbanks above village, Kwatta hede, Saramacca River, *23939.* This variety, apparently not previously published, differs from the typical form by its glabrous or nearly glabrous leaves. The type of *Solanum laetum* Miq. is in the Utrecht herbarium; a duplicate of the type of *S. sempervirens* Dunal in Leiden. Surinam and British Guiana.

SOLANUM RUGOSUM Dunal. SURINAM: shrub, vicinity Jacob kondre, Saramacca River, *23804a;* shrub to 4 m. high, flowers white, anthers yellow, bush to rear of village Pakka Pakka, Saramacca River, *23966.* West Indies, Guiana.

SOLANUM SURINAMENSE Steud. BRITISH GUIANA: frequent, tree 12 m. high, 10 cm. diam., flowers white, petals thick, frequently only shrub, opening in high forest, Kamuni Creek, Groete Creek, Essequibo River,

[124] By G. J. H. Amshoff.

[125] By G. J. H. Amshoff.

22900. SURINAM: frequent, shrub to 10 m. high, flowers blue, fruit cream, Charlesburg Rift, open scrub land, 3 km. north of Paramaribo, *22802.* Guiana, Brazil, Colombia.

SOLANUM HOSTMANNI Dunal. SURINAM: frequent, shrub 2–3 m. high, flowers white, anthers yellow, partly submerged in rapids, along river between Jacob kondre and Kwatta hede, Saramacca River, *23898.* Frequent in Surinam from the Corantyne River to the Marowyne River. The name *S. Hostmanni* Dunal has been retained by Bitter in his determinations of 1923.

SOLANUM JAMAICENSE Mill. BRITISH GUIANA: subshrub to 1 m. high, leaves firm, chartaceous, fruit purple-black, on rocky lateritic soil, Garraway Stream, Potaro River, *22962.* West Indies, continental tropical America.

SOLANUM PALUDOSUM Moric. SURINAM: shrub to 4 m. high, flowers blue, anthers yellow, trail to rear of village, Pakka Pakka, Saramacca River, *23970.* British Guiana (compared with *A. C. Smith 3183, 3659,* det. Morton) and Brazil. Two additional specimens from Surinam are: petals lilac, stamens yellow, savanna forest, forest reserve Sectie O, *Lanjouw 157;* petals purple, anthers yellow, shrub, Voltzberg foot, savanna forest, *Lanjouw 923.*

SOLANUM SUBINERME Jacq. SURINAM: frequent, shrub to 2 m., Charlesburg R.ft, 3 km. north of Paramaribo, *22728.* Trinidad, Guiana, Venezuela, Colombia, Brazil.

SOLANUM STRAMONIIFOLIUM Jacq. BRITISH GUIANA: frequent, suffrutescent plant to 2 m., flowers white, anthers yellow, fruit red, covered with stellate brown scurf, openings in mixed Mora forest, Kamuni Creek, Groete Creek, Essequibo River, *22905.* Trinidad, Guiana, Venezuela, Brazil.

SOLANUM RUBIGINOSUM Vahl. SURINAM: subshrub to 2 m. high, flowers white, in low bush, one specimen seen in opening n.w. of Savanna VIII, Tafelberg, *24425;* shrub to 3 m., petals pink, anthers yellow, turning black, overhanging stream, lower North Ridge Creek, Tafelberg, *24806;* also collected in Surinam by Geyskes (no. *1018,* Coppenam River near Tonckensfalls, flowers pink with yellow anthers, leaves lustrous, dark green above, greyish pubescent beneath); and by Splitgerber (no. *1168,* in wood of the Pará district, flowers lilac [L]). The latter specimen has been cited by Pulle in his Enumeration of the Vascular Plants known from Surinam, p. 471, but no authentic material from French Guiana could be compared. The species, as here interpreted, is somewhat variable, particularly in the form of the calyx segment.

MARKEA PORPHYROBAPHES Sandw. BRITISH GUIANA: rare, vine from *Ilex* tree, grows to 8 cm. diameter, rope, leaves leathery, flowers greenish, fleshy, calyx green, corolla tube 5-ribbed, young fruits waxen-white, oblong, pointed, Kaieteur Plateau, *23174.* Only known from British Guiana.

MARKEA COCCINEA Rich. SURINAM: infrequent, vine, scandent and climbing, flowers orange, leaves thick, glossy, high mixed forest, south rocky slopes, Arrowhead Basin, Tafelberg, *24606;* rope, flowers bright orange, high forest, base south cliffs, Arrowhead Basin, *24471.* Guiana, Amazonian district.

CESTRUM LATIFOLIUM Lam. var. TENUIFLORUM (H.B.K.) O. E. Schulz. SURINAM: shrub to 4 m., Charlesburg Rift, 3 km. north of Paramaribo,

22752; infrequent, liana, flowers pink, climbing to 30 meters, *22775.* Venezuela, Colombia, Guiana, Brazil, the typical form also in the West Indies.

BRUNFELSIA GUIANENSIS Benth. SURINAM: frequent, slender shrub to 2 m., along bush trail to rear of village, Jacob kondre, *23894.* The specimen is sterile and the identification therefore somewhat tentative. French Guiana and Surinam.

LENTIBULARIACEAE[126]

Genlisea nigrocaulis Steyermark, sp. nov. Herba 4–10 cm. alta; foliis liguliformibus vel spatulato-oblongis, obtusis, laminis 6–7 mm. longis, 1.5–2.5 mm. latis; scapis glandulari-pilosis; squamis 1–6, basifixis, ovatis, acutis, 1–1.5 mm. longis; bracteis basifixis, ovatis, obtusis, 0.75–1 mm. longis, pilosis; pedicellis 7–13 mm. longis, glandulari-pilosis; bracteolis lateralibus 2, distinctis, lanceolatis, acuminatis, 0.75–1 mm. longis, 0.3 mm. latis, pilosis; lobis calycinis inaequalibus, ovatis vel lanceolatis, acutis, 1–1.4 mm. longis, 0.4–0.75 mm. latis, pilosis; corolla lutea, labio superiore late ovato, obtuso, 3–3.5 mm. longo, 2.5–3.75 mm. lato, labio inferiore 3-lobato, 3.5–4 mm. longo, 3.75–5 mm. lato, lobis late suborbicularibus, rotundatis; calcari horizontali conico-oblongo, obtuso, 4–5 mm. longo, labio inferiore longiore.

Herb 4–10 cm. tall; leaves in a dense rosette, ligulate or spatulate-oblong, obtuse, the blades 6–7 mm. long, 1.5–2.5 mm. wide, petioles 4–25 mm. long; scapes 1 or more, erect, mostly blackish, usually glandular-pilose, the hairs elongated and multicellular; scales 1–6, basifixed, ovate, acute, 1–1.5 mm. long; flowers 1–7, loosely racemose; pedicels ascending, 7–13 mm. long, glandular-pilose; bracts basifixed, ovate, obtuse, 0.75–1 mm. long, 0.75 mm. wide, pilosulous; bracteoles distinct, lanceolate, acuminate, 0.75–1 mm. long, 0.3 mm. wide, pilosulous; calyx lobes 5, unequal, ovate to lanceolate, acute, 1–1.4 mm. long, 0.4–0.75 mm. wide, pilosulous; corolla yellow; upper lip broadly ovate, obtuse, 3–3.5 mm. long, 2.5–3.75 mm. wide; lower lip 3-lobed, 3.5–4 mm. long, 3.75–5 mm. wide, the lobes broadly suborbicular, rounded; spur horizontally projecting, conic-oblong, obtuse, 4–5 mm. long, longer than the lower lip; capsule pilose, about 2.5 mm. in diameter.

TYPE: corolla butter yellow, stems blackish as are pedicels and calyx, in swamp on open level portion of plateau on southeast-facing slopes, Ptari-tepuí, state of Bolívar, Venezuela, alt. 1600 m., Nov. 1, 1944, *Julian A. Steyermark 59644.* Chicago Natural History Museum. Cotype: locally frequent, perennial herb to 16 cm. high, stem pubescent or glabrous, flowers pale yellow, savannas, Kaieteur Plateau, British Guiana, May 4, 1944, *Maguire & Fanshawe 23201.* Chicago Natural History Museum; New York Botanical Garden.

Genlisea nigrocaulis is related to *G. roraimensis* N. E. Brown, from which it differs in the longer pedicels, many-flowered inflorescence, longer spur and details of corolla and calyx, and more densely glandular and longer-haired scapes, pedicels, bracts, and calyx. From *G. anfractuosa* Tutin of British Guiana it differs in the pubescent calyx lobes, as well as other characters, and from *G. pulchella* Tutin, also from British Guiana, in the pubescent calyx and larger corolla.

[126] By Julian A. Steyermark.

Although the type has densely glandular-pilose blackish scapes, pedicels, and calyx, the Maguire & Fanshawe collection has scapes varying from green to blackish and glabrous to glandular-pubescent.

UTRICULARIA AMETHYSTINA St.-Hil. & Gir. BRITISH GUIANA: locally occasional, to 20 cm. high, flowers purple, spur horizontal, lip with two white processes, wet sand on savannas, Kaieteur Plateau, *23290*. SURINAM: frequent, leaves broadly spatulate, bladders present, flowers purple, yellow protuberances in throat, shallow bogs, Savanna I, Tafelberg, *24197;* mossy banks of lower Augustus Creek, trail crossing, 0.5 km. above Falls, Tafelberg, *24727*. Venezuela and Trinidad to Brazil.

UTRICULARIA AMETHYSTINA f. **alutacea** (Tutin) Steyermark, comb. nov. *Utricularia alutacea* Tutin, Jour. Bot. **72**: 313–314. 1934. SURINAM: frequent, flowers white, grass savanna, Zanderij II, *23684;* infrequent, leaves spatulate, flowers white, bladders present, perhaps albino of *24197*, shallow bogs, Savanna I, Tafelberg, *24198*.

Although Tutin's fig. 4, p. 313 (Jour. Bot. **72**. 1934) shows the middle lobe of the lower corolla lobe prolonged and pointed, and is described as "longissimo acuto," this is not borne out by careful dissection of isotypic material (*Tutin 674* in U. S. National Herbarium). Although this middle part of the lower corolla is longer than the lateral lobes, it is obtuse and rounded. Other differences ascribed by Tutin to *U. alutacea* as distinct from *U. amethystina*, such as shape of leaf blade, sepal length, and glabrity of the corolla, are not borne out by examination of type material. Under magnification the spur and palate are found to be minutely puberulent. I can find no real differences separating these two species, which appear to agree in all respects except color. As a white-flowered form of *U. amethystina*, it seems at present logical to treat *U. alutacea* as such.

UTRICULARIA ANGUSTIFOLIA Benj. BRITISH GUIANA: occasional to locally frequent, perennial herb to 45 cm. high, leaves erect, flat, linear, flowers yellow, inflorescence branched, savannas, Kaieteur Plateau, *23205*. SURINAM: frequent, grass savanna, Zanderij II, *23685a.;* frequent, flowers white, grass savanna, Zanderij II, *23686;* common, leaves linear, flowers lavender, yellow protuberances, shallow bogs, Savanna I, Tafelberg, *24201*. Trinidad, Venezuelan Guyana, British Guiana, and Surinam.

UTRICULARIA HUMBOLDTII R. Schomb. BRITISH GUIANA: perennial aquatic herb growing in pools of water of *Brocchinia micrantha* leaves, leaves erect on long petioles, colorless bladders on subaerial leaves, leaves and flowers blue, savannas, Kaietur Platau, *23187*. Known only from British Guiana and the isolated table mountains of Venezuela, where it grows in water of the leaves of *Brocchinia Tatei,* the large bromeliad of that region. Although placed by Barnhart in *Orchyllium*, a study of the criteria by which he separates this and other genera from *Utricularia* does not appear to substantiate such segregation.

Utricularia kaieteurensis Steyermark, sp. nov. (fig. 24, A, B, C). Herba annua 11–25 cm. alta; foliis 1–2, suborbicularibus, rotundatis, laminis 4–5 mm. longis, 4–8 mm. latis; scapis glabris; squamis ovato-lanceolatis, acuminatis, 0.75 mm. longis; bracteis 3, subaequalibus, ovato-lanceolatis, acutis, 1 mm. longis, lateralibus distinctis, angustioribus; pedicellis 6–7 mm. longis; calycis lobo superiore late ovato, subobtuso, 3 mm. longo, 2 mm. lato, glandulari-puberulenti; calycis lobo inferiore minore, suborbi-

cular, paullo emarginato vel bilobato, 1.5 mm. longo, 1.5 mm. lato, glandulari-puberulenti; corolla alba, per omnes partes glandulari-pilosa, labio superiore late ovato, obtuso, subemarginato, 3.5 mm. longo, 2.5 mm. lato; labio inferiore suborbiculari, late 3-lobato, 4 mm. longo, 4 mm. lato; calcari descendente, 5 mm. longo.

Herb 11–25 cm. tall; leaves 1 or 2, radical, suborbicular, rounded, the blades 4–5 mm. long, 4–8 mm. wide; scape solitary, glabrous; scales 5–7, ovate-lanceolate, acuminate, 0.75 mm. long; inflorescence racemose, 1–3-flowered; pedicels 6–7 mm. long; bracts 3, subequal, ovate-lanceolate, acute, 1 mm. long, the lateral ones distinct, narrower than the middle bract; upper calyx lobe broadly ovate, subobtuse, 3 mm. long, 2 mm. wide, glandular-puberulent; lower calyx lobe smaller, suborbicular, shallowly emarginate or bilobate at apex, 1.5 mm. long, 1.5 mm. wide, glandular-puberulent; corolla white, glandular-puberulent throughout, upper lip broadly ovate, obtuse, subemarginate, 3.5 mm. long, 2.5 mm. wide; lower lip suborbicular, broadly 3-lobed, the lobes broadly rounded, about 4 mm. long and 4 mm. wide; spur descending, conic in lower half, narrow-cylindric in upper portion, 5 mm. long; ovary glandular-puberulent; capsule about 2.5 mm. long, glandular-puberulent.

TYPE: occasional to rare, perennial herb to 25 cm. high, stems delicate, rhizomes fragile, minute bladders, leaves 2–8 mm. broad, spatulate, flowers white, sedge bog on savanna, Kaieteur Plateau, British Guiana, May 4, 1944, *Maguire & Fanshawe 23204*. Chicago Natural History Museum; New York Botanical Garden.

This species differs from *U. hirtella* St.-Hil., a related Brazilian species, in its much larger corolla, glabrous stems and pedicels, and bracts divided to the base. It possesses, among other characters, a puberulent calyx and corolla, in these respects resembling a closely related species to be described from the Venezulan Guyana.

UTRICULARIA LONGECILIATA DC. BRITISH GUIANA: occasional to frequent, annual herb to 25 cm. high, basal rosette of leaves, flowers yellow, in damp sand, Kaieteur Plateau, *23114*. SURINAM: frequent, flowers white, grass savanna, Zanderij II, *23685*. Dutch and British Guiana, Venezuela, and Brazil.

Utricularia Maguirei Steyermark, sp. nov. (fig. 24, A, B). Herba 11–30 cm. alta; foliis obovatis vel spatulatis, rotundatis, 1–3 cm. longis, 0.7–1.5 cm. latis; scapis glabris; squamis lanceolatis, acuminatis, 2.5–3 mm. longis, glabris; bracteis lanceolatis, 2–2.5 mm. longis, 0.5 mm. latis; bracteolis brevioribus, triangulari-subulatis, 1.5 mm. longis, 0.3 mm. latis; pedicellis 3–3.5 mm. longis; calycis lobo superiore late ovato, abrupte acuminato, minute ciliolato, 4.25 mm. longo, 4 mm. lato; calycis lobo inferiore suborbiculari-ovato, apice bidentato, minute ciliolato, 4.25 mm. longo, 5 mm. lato; corolla lilacea, extus glandulari-puberula, labio superiore oblongo, obtuso, 5 mm. longo, 3.5 mm. lato; labio inferiore late obovato, apice rotundato, 6.5 mm. longo, 6.75 mm. lato; calcari 5.5–6.5 mm. longo.

Herb 11–30 cm. tall; leaves 3–4, rather thin, inconspicuously nerved, obovate to spatulate, rounded above, gradually decurrent on petiole, including the petiole 1–3 cm. long, 0.7–1.5 cm. wide; scape solitary, glabrous; scales 3–4, lanceolate, acuminate, 2.5–3 mm. long; raceme terminal, simple or branched, 3–11-flowered, the flowers rather remote, 1.5–2.5 cm. distant;

pedicels 3–3.5 mm. long, glabrous; middle bract lanceolate, 2–2.5 mm. long, 0.5 mm. wide; bracteoles shorter, triangular-subulate, 1.5 mm. long, 0.3 mm. wide; upper calyx lobe broadly ovate, abruptly acuminate, minutely ciliolate, 4.25 mm. long, 4 mm. wide; lower calyx lobe suborbicular-ovate, bidentate at apex, minutely ciliolate, 4.25 mm. long, 5 mm. wide; corolla lilac, glandular-puberulent without, upper lip oblong, obtuse, 5 mm. long, 3.5 mm. wide; lower lip broadly obovate, rounded at apex, 6.5 mm. long, 6.75 mm. wide; spur horizontal, equaling or slightly longer than lower lip, 5.5–6.5 mm. long.

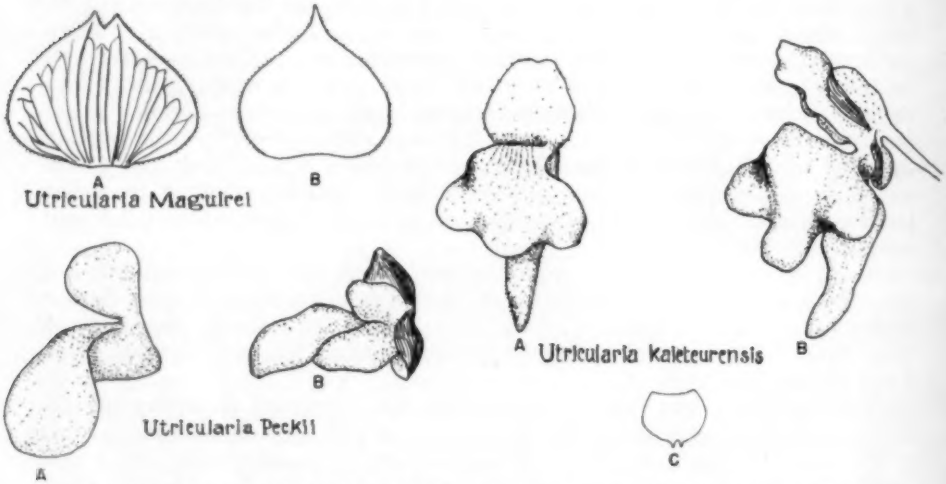

FIG. 24. *Utricularia kaieteurensis* Steyermark, sp. nov. (right). A. corolla, nearly anterior view (×11). B. corolla and calyx, lateral view (×12). C. lower calyx lobe (×10). *Utricularia Maguirei* Steyermark, sp. nov. (upper left). A. lower calyx lobe (×10). B, upper calyx lobe (×10). *Utricularia Peckii* Blake (lower left). A. corolla showing short bluntish spur (×10). B. corolla and calyx, with lower corolla lobe raised to show attachment of low broad spur (×9).

TYPE: locally common, to 30 cm. high, leaves spatulate, flowers lilac, wet sand on savannas, Kaieteur Plateau, British Guiana, May 5, 1944, *Maguire & Fanshawe 23249*. Chicago Natural History Museum; New York Botanical Garden.

This species belongs to that section of the genus characterized by such species as *U. longifolia* Gardn., *U. reniformis* St.-Hil., *U. nelumbifolia* Gardn., and *U. calycifida* Benj. It simulates *U. calycifida*, but that species is described as having a yellow corolla. Distinguished by its short spur, short lower corolla lip, suborbicular lower calyx lobe, and cuspidate upper calyx lobe, it is most closely related to a species to be described later from one of the table mountains in the Venezuelan Guyana.

UTRICULARIA PECKII Blake. *U. rubricaulis* Tutin. BRITISH GUIANA: locally frequent, perennial herb to 5 cm. high, flowers subsessile, yellow, wet sand on savannas, Kaieteur Plateau, *23200*. SURINAM: frequent, flowers white, grass savanna, Zanderij II, *23687*. British Honduras, Dutch and British Guiana.

An examination of type material of *Utricularia rubricaulis* Tutin (*Tutin 669,* in U. S. National Herbarium) reveals that it is conspecific with *U. Peckii* Blake, described from British Honduras. Although Tutin's description of the spur as "4.5–5.0 mm. longum, conicum acutum,"[127] accompanied by his fig. 5, would indicate that it was quite different from that described by Blake,[128] actually such is not the case. Careful dissection of isotypic material (*Tutin 669*) shows the spur to be a short, rounded, gibbose, blunt process only 1–1.5 mm. long and 2 mm. broad. It is certainly not acute and the measurement given by Tutin is erroneous. Blake correctly described the type of spur in *U. Peckii*, and this is the same as that found in Tutin's collection, as well as in carefully preserved material collected by Maguire and Fanshawe (*23200*) (fig. 24, A, B). Although Tutin[129] states that "Some time was devoted to examining the species of *Utricularia* in the field, and it was found that such characters as the direction of the spur and the colour of the flowers were very constant. . . . Consequently any tendency to 'lump' species described from Tropical America as a result of the examination of herbarium material alone is probably unjustified," it is not quite understandable how such an important character as the spur could be described as erroneously as in this case.

Other statements found in the description of *U. rubricaulis* and not borne out by examination of type material are the following: (1) the length of the sepals, stated to be 1.5 mm., was found to be 2 mm.; (2) the upper calyx lobe, described as acute, was found to be obtuse; (3) the upper corolla lobe, described as 2 mm. long, measured 2.5–3 mm. long; (4) the lower corolla lobe varied from 4–4.5 mm. long, although in the description it is stated to be 4 mm. long.

For the affinities with other species, Tutin compares his *U. rubricaulis* with *U. adpressa* St.-Hil., *U. Peckii* Blake, and *U. virgatula* Barnh. [= *U. juncea* f. *virgatula* (Barnh.) Fern.]. Of these, *U. Peckii* is the only one with which it can be compared closely, since the others mentioned all have a much longer spur and an acute to acuminate upper calyx lobe. The two species (*U. Peckii* and *U. rubricaulis*) are supposed to differ chiefly in size of flower and length of pedicels, but such differences are not found when careful examination is made of type material. With no other outstanding characteristics separating these species, and with the description of the spur of *U. rubricaulis* erroneous as shown by an examination of type material, I am uniting the two under the earlier name, *U. Peckii.*

UTRICULARIA PELTATA (Spruce) Oliver. BRITISH GUIANA: infrequent, 8–10 cm. high, flowers lilac with purple spot on lip, on shady stream bank, savanna, Kaieteur Plateau, *23240.* Known only from Brazil and British Guiana.

UTRICULARIA SUBULATA L. BRITISH GUIANA: abundant in marshy areas, savannas, Kaieteur Plateau, *23166.* SURINAM: common, fine linear leaves on delicate rhizomes, flowers yellow, shallow bogs, Savanna I, Tafelberg, *24200.* Widely distributed, in the United States from Mass. to Fla. and Tex., near the coast, south to Mexico, West Indies, Central America, and South America.

[127] Jour. Bot. 72: 312. 1934.

[128] Contr. Gray Herb. 52: 90. 1917.

[129] Jour. Bot. 72: 306. 1934.

UTRICULARIA SUBULATA f. CLEISTOGAMA (Gray) Fern. SURINAM: frequent, flowers white, grass savanna, Zanderij II, *23688*. Occurring within the range of the species. This small-flowered form, with usually shorter spurs and creamy or whitish corollas, may occur with the species or in separate stands. Various intermediate types are found between the smallest extremes and the large typical form of the species.

BIGNONIACEAE[130]

ARRABIDAEA CANDICANS (Rich.) DC. BRITISH GUIANA: liana, leaves glaucous below, flowers mauve, occasional to locally frequent, from *Aniba excelsa* in wallaba bush, Kaieteur Savanna, *23223*. SURINAM: leaves glaucous below, flowers lavender, buds velvety-purple, savanna vicinity Sectie O, *25020*. Tropical America, widely distributed from British Honduras and Costa Rica to Bolivia and Amazonian Brazil.

Arrabidaea Fanshawei Sandwith, sp. nov. Sect. *Microcarpaeae*. *A. Agno-casto* (Cham.) DC. affinis, foliolis fere concoloribus subtus haud griseo-tomentellis, calyce corollaque majoribus, corollae tubo antice curvato, staminibus longioribus scilicet anticis e corrola paullo exsertis, ovario laevi, ovulis pro loculo pluribus differt.

Frutex alte scandens, cirrhis ut videtur simplicibus; ramuli velut petioli, petioluli, inflorescentia ubique griseo-tomentelli, teretes, tenuiter costati, nodis inter petiolos consociebus glandularum praediti; pseudostipulae haud evolutae. *Folia* 2–3-foliolata; petioli 1–6 cm. longi; petioluli supra canaliculati, laterales 0.5–1.4 cm., terminales 2.0–2.5 cm. longi; foliola elliptica, ovato-elliptica vel obovato-elliptica, terminalia obovata, apice cuspidata, basi rotundata vel obtusa ac obliqua, 5–12 cm. longa, 2.5–7.0 cm. lata, firme chartacea vel tenuiter coriacea, fere concolora, supra oculo nudo glabra sed sub lente forti praesertim secus costam nervosque minute pubescentia, subtus secus costam nervosque copiose necnon tota pagina sparse pubescentia, haud punctulata, nervis primariis utrinsecus costae 5–7 his cum costa supra planis subtus promentibus, venulis intricatissime reticulatis subtus prominulis. *Inflorescentia* terminalis, ampla, speciosa, scilicet thyrsum pyramidalem circiter 15–25 cm. latum ubique griseo-tomentellum efformans; rami primarii inferiores ex axillis foliorum plane evolutorum orientes, ascendentes, ad 25 cm. longi, superiores sursum arcuati; ramuli secundarii breves, apice trichotomias cymarum congestarum gerentes; pedicelli 0.5–1.5 cm. longi. *Calyx* turbinato-campanulatus, ore integro vel brevissime denticulato, 3.5–4.5 mm. longus, 3.5–5.0 mm. latus, extra griseo-tomentellus, statu vivo violaceo-purpureus. *Corolla* parva, violaceo-purpurea, anguste infundibulari-hypocrateriformis; tubus subcylindricus, 1 cm. longus, dimidio inferiore rectus glaber 2 mm. diametro, superiore curvatus sensim paullo (ad 3.5 mm.) ampliatus extra furfuraceo-tomentellus, intus infra lobos labii inferioris pilosus; limbus conspicue bilabiatus, 1.0–1.5 cm. diametro, extra furfuraceo-tomentellus; labium superius ad ¼ tantum fissum, 5.0–7.5 mm. longum 5.0–6.5 mm. latum, intus infra lobos nisi prope margines glabrum; labium inferius fere ad basin fissum, lobis obovato-spathulatis 4.0–6.5 mm. longis 3–4 mm. latis intus papilloso-pubescentibus. *Stamina* prope medium tubi inserta; antica (longiora) 5.5–6.0 mm. longa thecis ex ore corollae

[130] By N. Y. Sandwith.

exsertis, postica 3.5–4.0 mm. longa, quintum staminodiale anantherum 1.75 mm. longum, omnia basi dilatata atque conspicue lepidoto-papillosa; thecae antherarum divergentes, glabrae, 0.8–1.0 mm. longae, connectivo in apiculum minutum conicum producto. *Discus* pulvinatus, 0.4–0.6 mm. altus. *Ovarium* ellipsoideo-oblongum, subquadrangulare, 1.0–1.5 mm. longum, glabrum vel glabrescens; stylus glaber, 6 mm. longus, stigmatibus brevibus vix 0.5 mm. longis; ovula biseriata, in quaque serie 5–6. *Capsula* non visa.

TYPE: 10 cm. diam., medium-hard, grey-brown rope from crown of an Eschweilera in mixed forest, calyx and corolla violet-purple, Mazaruni Station, British Guiana, January 24, 1944, *Fanshawe* in *F.D. 4288*. Kew Herbarium; New York Botanical Garden. British Guiana: rope from crown of fallen Catostemma, young shoots gray-green, leaves thinly leathery, calyx pale purple, corolla purple, Takutu Creek to Puruni River, Mazaruni River, *Fanshawe* in *F.D. 4810*.

ARRABIDAEA INAEQUALIS (DC. ex Splitg.) K. Schum. SURINAM: liana climbing to 30 m., flowers pink, infrequent at Charlesburg Rift, secondary jungle, 3 km. north of Paramaribo, *22775*. Trinidad, Guiana, Amazonian Brazil and Venezuela.

ARRABIDAEA NIGRESCENS Sandwith, forma? SURINAM: rope, flowers dark purple, high mixed wallaba forest, vicinity of Camp No. 2, km. 7, Saramacca River Headwaters, *24877*. British Guiana, Amazonian Brazil. If correctly interpreted, the first record for Surinam.

The material is poor and is referred to this species with some doubt, as a form with the indumentum of the leaflets composed of very minute branched hairs, and the inflorescence with shorter branches and therefore narrower in aspect. A recent collection of *A. nigrescens* in British Guiana, *F1508* (*F.D. 4244*), 107 miles Bartica-Potaro Road, Nov. 16, 1943, bears fruit, which may now be described for the first time: capsule elongate-linear, narrowed to an obtuse apex and base, 40–43 cm. long, 2.5 cm. broad, glabrous, impressed-lepidote, the valves rigid and woody, with a rather thin and barely prominent median rib. Seeds large, up to 2 cm. long and 7 cm. or more broad, glabrous, the embryo pale brown, the wings papery-membranous, scarcely or slightly hyaline, string-colored. The capsule, therefore, as would have been expected, closely resembles that of *A. mollis* (Vahl.) Bur. et K. Schum. *A nigrescens* appears to be variable in the quantity and size of the hairs composing the indumentum of the leaflets; it may eventually prove to be only a variety of a polymorphic species *A. mollis*.

PARAGONIA PYRAMIDATA (Rich.) Bur. BRITISH GUIANA: liana, flowers mauve pink, occasional on riverside, Potaro River above Kaieteur Fall, *23366;* Waiapi Creek, lower Mazaruni River, *F1409* (*F.D. 4145*). SURINAM: rope, flowers deep pink, Toekoemoetoe Creek, Saramacca River, *24918;* flowers pink, vicinity Sectie O, km. 68, *25001*. Widely distributed on Continental Tropical America, Trinidad, Tobago and Guadeloupe.

POTAMOGANOS MICRCCALYX (G.F.W. Mey.) Sandw. BRITISH GUIANA: black rope 2 cm. diam., leaves paired, stalked on common petiole, flowers in axillary inflorescences, paired on inflorescence, glabrous, corolla tubular, magenta-purple, Mazaruni Station, *F1267* (*F.D. 4003*); Madray-Bubu trail Essequibo-Demerara, *F1684* (*F.D. 4420*). British Guiana and Surinam.

ROENTGENIA SORDIDA (Bur. & K. Schum.) Sprague & Sandwith. BRITISH GUIANA: rope 4 cm. diam., flowers in terminal inflorescences, tubular, Takutu Creek to Puruni River, Mazaruni River, *F2117* (*F.D. 4853*). Guiana, Amazonian Brazil.

CYDISTA AEQUINOCTIALIS (L) Miers. SURINAM: vine, flowers lavender, deeply striped within throat, frequent along river near Brokolonka, Saramacca River, *23797;* liana, corolla lobes deep lavender, throat lined purple, tube white, frequent on Tawa Creek, Saramacca River, *24076;* liana, corolla white, mixed high forest at base of west escarpment, Tafelberg, *24700*. Tropical America; variable and widely distributed, from Central America to the West Indies, Colombia, Venezuela, and Amazonian Brazil and Peru.

ANEMOPAEGMA PARAËNSE Bur. & K. Schum. BRITISH GUIANA: rope 5–10 mm. diam., flowers constricted above calyx, fascicled, axillary or lateral, calyx tubular, Barima River opposite Anabisi Creek *F2464* (*F.D. 5200*). Trinidad, Guiana, Amazonian Brazil and Peru.

Anemopaegma Maguirei Sandwith, sp. nov. *A. citrino* Mart. ex DC. ex descriptione ut videtur affinis, habitu, petiolis petiolulisque brevioribus, indumento diverso magis evoluto, foliolis opacis basi cordatulis differt; ab *A. umbellato* A. Samp. habitu, indumento et praecipue forma foliolurum statim distinguitur.

Frutex scandens; ramuli subteretes, costato-striati, costis senectute longitudinaliter rimoso-fissis, dense satis minute pilosulo-pubescentes; pseudostipulae haud evolutae. *Folia* 2–3-foliolata, 2-foliolata nonnunquam cirrho apice uncinato-trifurcato terminata; petioli 2–3 cm. longi, velut petioluli pilosulo-pubescentes; petioluli laterales breves, 2–4 mm. tantum longi, petiolulus terminalis ad 9 mm. longus; foliola elliptica vel ovato-elliptica, apice breviter vel brevissime late acuminata, basi rotundata atque distincte cordatula, 7–9 cm. longa, 2.8–4.3 cm. lata, summa minora, coriacea marginibus revolutis, siccitate supra olivacea opaca subtus pallide viridia, secus costam utrinque praesertim supra pubescentia, ceterum glabra nisi secus margines prope basin, utrinque (subtus crebrius) punctato-lepidota, subtus etiam dense minutius lepidota, praeterea subtus basi utroque costae latere glandulis patelliformibus foveolis insidentibus praedita, costa supra canaliculato-impressa subtus velut nervis primariis valde promenente, his utroque costae latere 6–7 arcuato-ascendentibus ac anastomosantibus, rete venularum utrinque prominulo. *Inflorescentia* axillaris, thyrsum brevem racemiformem pauciflorum vix 2 cm. longum ubique pilosulo-puberulum efformans; bracteae obscurae, filiformi-oblongae, circiter 1 mm. longae; pedicelli circiter 5 mm. longi. *Calyx* cupulato-campanulatus, satis brevis, 4–6 mm. longus, ad 8 mm. latus, extra pilosulo-pubescens atque dimidio superiore consociebus glandularum praeditus, margine sinuato ciliolato haud denticulato. *Corolla* campanulato-infundibularis, subrecta vel parum curvata, membranacea, lobis inclusis ad 6.5 cm. longa; tubus pallide flavus, parte basali cylindrica circiter 1.4 cm. longa 7 mm. lata, extra dense minute lepidotus, intus satis sparse punctato-lepidotus praeterea circa insertionem staminum zona pilorum hyalinorum papilliformium praeditus; limbus cremeo-albus, 3 cm. diametro, lobis ciliolatis utrinque punctato-lepidotis extra prope medium glandulis patelliformibus sparsis instructis. *Stamina* circiter 1.3 cm. supra tubi basin inserta, longiora (antica) 2.5 cm. breviora 2.1 cm. longa; staminodium 6 mm. longum; antherarum thecae divergentes, 4 mm.

longae. *Discus* pulvinatus, 1.5 mm. altus. *Ovarium* ellipsoideum, basi supra discum contractum, 3 mm. longum, 2 mm. latum, minutissime lepidotum; stylus glaber, 4 cm. longus; ovula pro loculo quadriseriata, in quaque serie 4–5. Capsula ignota.

TYPE: vine, corolla tube pale yellow, lobes cream-white, in high bush northeast of Savanna I, Tafelberg, Surinam, August 17, 1944, *Maguire 24403*. Kew Herbarium; New York Botanical Garden.

This plant is quite unmatched in the Kew material and is noteworthy for the indumentum of the vegetative parts and calyces, the absence of developed pseudostipules, the unusually short petiolules, the small opaque coriaceous leaflets which are distinctly though very slightly cordate at the base, the very short lateral inflorescences and the short calyces. The nearest relative, perhaps very closely allied, is apparently *A. citrinum* Mart. ex DC., of which no specimen has been available for examination. From the evidence of Schumann's description in the Flora Brasiliensis, *A. citrinum* produces branchlets with an erect fruiticose habit (although tendril-bearing leaves are also present), the petiolules (and the petioles of lower leaves) are longer than those of Dr. Maguire's plant, and their indumentum is composed of curved ferrugineous-puberulous hairs, evidently differing from that of *Maguire 24403* which consists of stiff, mostly straight, whitish-hyaline hairs. *A. citrinum* is further described as having the leaflets shining above and truncate or obtuse at the base, the calyx merely lepidote (not pubescent), and a shorter, curved corolla. It has been once collected, by Prince Wied-Neuwied in the state of Bahia, Brazil. *A. velutinum* Mart. ex DC. still further differs on account of the dense conspicuous indumentum on all the vegetative parts; while *A. umbellatum* A. Samp., which has very short petiolules, is glabrous and has remarkable long and narrowly elliptic-lanceolate leaflets.

CLYTOSTOMA BINATUM (Thunb.) Sandwith. SURINAM: rope, flowers lavender, white within throat, overhanging Toekoemoetoe Creek, Saramacca River, *24913*. Tropical South America, Venezuela, Guiana, Brazil and Paraguay.

MARTINELLA OBOVATA (H.B.K.) Bur. & K. Schum. BRITISH GUIANA: liana, occasional on riverside, Potaro River above Kaieteur Falls, *23360*. Widely distributed in Continental Tropical America, also in St. Vincent, Tobago and Trinidad.

DISTICTELLA RACEMOSA (Bur. & K. Schum.) Urb. BRITISH GUIANA: liana, fruit flat convex greenish with sunken warts, frequent on riverside, Potaro River above Kaieteur Falls, *23358;* Kauria Creek, lower Cuyuni River, *F1424* (*F.D. 4160*); Groete Creek, Essequibo River, *F1760* (*F.D. 4496*). Guiana, Amazonian Brazil, Colombia, Tobago.

STIZOPHYLLUM sp. BRITISH GUIANA: rope, leaves trifoliate, fruit long, flat, black. Takutu Creek to Puruni River, Mazaruni River, *F2067* (*F.D. 4803*).

MEMORA FLAVIFLORA (Miq.) Pulle. BRITISH GUIANA: vine, black, wiry stems, branching at right angles, flowers stalked, axillary, tubular, yellow. Mazaruni Station, *F795* (*F.D. 3531*). Guiana.

MEMORA SCHOMBURGKII (DC.) Miers. BRITISH GUIANA: Groete Creek, Essequibo River, *F1719* (*F.D. 4455*). SURINAM: vine, flowers white, frequent in bush to rear of village, Jacob kondre, Saramacca River, *23862;*

vine, flowers yellow, overhanging Tafelberg Creek, Saramacca River, *24908*. Widely distributed in northern South America.

PACHYPTERA KERERE (Aubl. emend. Splitg.) Sandwith. BRITISH GUIANA: rope, 1 cm. diam., stems squarish, glandfields at nodes, pseudo-stipules, flowers in drooping inflorescences, flowers milk white, stamens woolly, Mazaruni Station, *F1419* (*F.D. 4155*). Central America, Colombia, Venezuela, Guiana and Amazonian Brazil.

CALLICHLAMYS LATIFOLIA (Rich.) K. Schum., forma. BRITISH GUIANA: rope 5 cm. diam., flowers in axillary thyrses, buds oblong-globose, corolla yellow, fruit elliptical, flattened, green, seeds brown, flat, rounded with membranous wing, Baramanni Creek, Waini River, N.W.D., *F2339* (*F.D. 5075*). Bartica-Potaro Road, *F1503* (*F.D. 4239*). Panama, Colombia, Venezuela, Trinidad, Guiana, Brazil, Bolivia.

MADFADYENA UNCATA (Andr.) Sprague & Sandwith. BRITISH GUIANA: vine flowers yellow, fruit dark brown, claw-like tendril sometimes replaces terminal leaflet, Mazaruni Station, *F2198* (*F.D. 4934*). Mexico, Venezuela, Trinidad, Guiana, Amazonian Brazil, Bolivia.

TABEBUIA INSIGNIS (Miq.) Sandwith var. MONOPHYLLA Sandwith (*T. longipes* Baker). BRITISH GUIANA: small tree to 4 m., 4 cm. diam., simply branched, leaves thickly leathery, flowers fascicled in forks of stem, white, locally frequent on Kaieteur Savannah, *23262;* Mazaruni Station, *F528* (*F.D. 3264*). Surinam, British Guiana.

TABEBUIA CAPITATA (Bur. & K. Schum.) Sandwith. BRITISH GUIANA: Moraballi Creek, Essequibo River, *F1283* (*F.D. 4019*); small, weakly branched tree, yellow flowers, frequent on Savanna III, Tafelberg, *24401*. Guiana, Amazonian Brazil.

TABEBUIA SERRATIFOLIA (Vahl) Nichols. BRITISH GUIANA: seedlings from below parent tree which was in flower at the time, Groete Creek, lower Essequibo River, *F1242* (*F.D. 3978*).

TABEBUIA SUBTILIS Sprague & Sandwith. BRITISH GUIANA: tree 5 m., 8 cm. diam., usually flowering without leaves, flowers bright yellow, pendent, crinkled, fruit brown-green, cylindrical, pendent, below Tukeit, Potaro River Gorge, *23493*. At present known only from the rocky banks of rivers in British Guiana.

TABEBUIA STENOCALYX Sprague & Stapf. BRITISH GUIANA: tree 80 ft. high, 12 in. diam., buttressed to 6 ft., adventitious shoots from base of trunk, flowers stalked terminally, bracteose, fruit cylindrical, seeds green with white membranous lining, Groete Creek, lower Essequibo River, *F1260* (*F.D. 3996*)., Groete Creek, Essequibo River, *F1743* (*F.D. 4479*).

TABEBUIA IPE (Mart.) Standl. var. INTEGRA (Sprague) Sandwith. SURINAM: mixed high forest, near north escarpment, Savanna I to foot of Augustus Falls, Tafelberg, *24751*. Brazil, Paraguay, northern Argentina. The first record from Surinam.

TABEBUIA sp. SURINAM: shrub to 2 m. high, flowers white, frequent on Savanna VIII, Tafelberg, *24639*.

The material is insufficient for specific determination or description, but suggests a form of *T. roraimae* Oliv. with young and relatively thin leaflets. *T. roraimae* has been known previously only from the Pacaraima Range.

JACARANDA RHOMBIFOLIA G.F.W. Mey. SURINAM: tree, flowers pale pur-

ple, frequent overhanging river between Pakka Pakka and Kwatta hede, Saramacca River, *24950*. Northern South America, Venezuela to Guiana.

SCHLEGELIA SPRUCEANA K. Schum. BRITISH GUIANA: rope 1 cm. diam.; flowers cauliflorous, crimson, young fruit oblong-globose, Takutu Creek to Puruni River, Mazaruni River, *F2096* (*F.D. 4832*).

PHRYGANOCYDIA CORYMBOSA (Vent.) Bur. & K. Schum. BRITISH GUIANA: rope, calyx white, corolla mauve-pink, 2-lipped, Mazaruni Station, *F1188* (*F.D. 3924*).

PSEUDOPAEGMA OLIGONEURON Sprague & Sandwith. BRITISH GUIANA: rope 2 cm. diam., flowers stalked, clustered in axils, corolla yellow, Mazaruni Station, *F1263* (*F.D. 3999*).

ACANTHACEAE[131]

In the following list the genera and species are dealt with in the same sequence as in my revision of the Acanthaceae in Pulle's *Flora of Suriname* (**4**: 166–254. 1938). The numbers in brackets refer to the pages of the latter where the descriptions are to be found.

MENDONCIA ASPERA Ruiz & Pav. (175). SURINAM: vine, bracts green, fruit very dark red, along railroad near km. 70, *23611;* bush to rear of Pakka Pakka, Saramacca River, *23971*.

APHELANDRA PARAENSIS Lindau (190). SURINAM: flowers scarlet, jungle to rear of Posoegronoe, *24029*. The collector describes this plant as a small shrub, but it is in reality a herb with a single unbranched stem, decumbent and rooting at the base.

APHELANDRA PECTINATA Willd. ex Nees (193). BRITISH GUIANA: frequent, large shrub with spikes encased in sheathing pink-brown, ciliate bracts, the spikes looking like candles on the shrub when in bud, calyx more or less pink, corolla scarlet with white hairs, Essequibo River, Keriti Creek, on loam along the creek, *F875* (*F.D. 3611*). SURINAM: Charlesburg Rift, 3 km. north of Paramaribo, on former sea beach consisting of deep sands underlain by shells, the sands covered by shrub and bordered by swamps and primary jungle, *22727;* Saramacca River, Jacob Kondre, in swampy bush along the trail, *23873*.

TRICHANTHERA GIGANTEA (Humb. et Bonpl.) Steud. (196). BRITISH GUIANA: soft-wooded tree of irregular growth, flowers scented like elder, calyx grey-green, pubescent, corolla tube in the lower half crimson and shiny, in the upper half like the reverse of the limb orange and pubescent, the upper side of the limb and the throat crimson and shiny, style nearly white, ovary yellow, Mazaruni Forest Station, *F624* (*F.D. 3360*).

HYGROPHILIA SANDWITHII Brem. Kew Bull. **1939**: 559. 1940. BRITISH GUIANA: procumbent herb with pink flowers, Mazaruni Station, local on sandy fore-shore, *23564*. Differs from *H. guyanensis* Nees (209) by the small number of flowers, usually but one, in the axillary cymes.

HYGROPHILIA ERECTA (Burm. f.) Hochr. *H. quadrivalvis* Nees. SURINAM: frequent in the swamps east of the Agricultural Experiment Station, Paramaribo, *22710*. This is an east-Asiatic species, and as it has never before been collected in Surinam, it is probably a recent introduction.

Polylychnis essequibensis Brem. sp. nov. Habitu scandente, ramis teretibus, panicula multo breviore, calycis lobis subulatis, granulis pollinis

[131] By C. E. B. Bremekamp.

majoribus et alveolis pariete multo humiliore instructis ornatis, disco haud unilateraliter producto a *P. fulgenti* Brem. recedens; typus: *Maguire & Fanshawe 22944* in herbario trajectino.

Frutex scandens, glaber. Rami internodiis primum quadrisulcatis, mox teretibus, sicc. negrescentes. Folia petiolo canaliculato 3–12 mm. longo instructa; lamina subcoriacea, ovato-oblonga, foliorum minorum interdum elliptica, 5–11 cm. longa et 1.7–4.5 cm. lata, apice acuta vel longius acuminata, basi contracta, margine subintegra, utroque latere costae nervis 5–9 utrinque prominulis, venulis paucis subtus prominulis. Panicula pedunculo 1.5–2.5 cm. longo subglabro elata, axi pedunculo subaequilonga; ramuli infimi circ. 1 cm. longi, semel vel bis dichasialiter ramificati. Ramuli infimi interdum foliis magnitudine valde redactis suffulti, alii bracteis subulatis 1.5–2.0 mm. longis, pubescentibus. Bracteae ultimae vix 0.5 mm. longae, ceterum aliis similiores. Pedicelli 2 mm. longi, sicc. cystolithis parvis albido-punctati. Calyx subglaber tubo 2.5 mm. diam. et 1.5 mm. alto, lobis subulatis 5–6 mm. longis, margine vix conspicue ciliolatis. Corolla rubra 5–6 cm. longa, tubo incurvato ad basin 2 mm., dimidio superiore 10 mm. diam., faucem versus paulo contracto, basin versus puberulo, labiis 10 mm. longis, superiore in lobulos 5 mm. longos fisso, basi calcarato, inferiore usque ad basin in lobos tres aequaliter diviso. Stamina 11 mm. infra divisuras corollae inserta; filamenta vix conspicue puberula basi in membranam 2.5 mm. altam connata, partibus liberis 11.5 et 13 mm. longis; antherae 3 mm. longae. Granula pollinis 83 μ diam., intra membranam 78 μ, alveolis 12 μ diam., bene distinguendis. Discus integer, 0.7 mm. altus, glaber. Ovarium quoque loculo ovulis 3–4, 5 mm. altum, glabrum. Stylus vix conspicue puberulus, corollae subaequilongus. Lobus stigmaticus anticus 2 mm., posticus 0.6 mm. longus. Capsula nondum visa.

Habitat Guianam Anglicam.

TYPE: mixed forest, rare, Groete Creek, Kamuni Creek, Essequibo River, 21 April, 1944, *Maguire & Fanshawe 22944*. British Guiana: 12 March 1944, Mazaruni Forest Station, *F1761* (*F.D. 4497*).

The short conical spur at the base of the upper lip gives the unopened flower a truncate shape, the upper end of the truncate top being formed by the spur. The disk lacks the tooth which gives that of *P. fulgens* its peculiar shape, and the alveoles of the pollen grains are separated from each other by much lower walls. The generic description is to be revised on these points.

In the description of the genus *Polylychnis* (Rec. Trav. Bot. Néerl. **35**: 160. 1938) the latter was compared with *Lychniothyrsus* Lindau (Notizbl. Bot. Gart. Berlin-Dahlem **6**: 192. 1914) and with *Stemonacanthus* Nees (Fl. Bras. **9**: 53. 1847). By the courtesty of the Director of the Royal Botanic Gardens, Kew, I have had since then an opportunity to study an example of Lindau's type. It proved to be a plant with small sessile flowers, very similar to *Ruellia ochroleuca* Nees, l.c. 56, *pl. 5*, and to the other American *Ruellia* species recognized by Nees, viz. *R. tetragona* Link, *R. alba* Nees, and *R. hygrophila* Nees. All these plants are provided with a glandular-hirsute indumentum, more or less distinctly crenate leaves and a slightly zygomorphic corolla. As they can not be left in *Ruellia L.*, which, as I have argued elsewhere, is to be confined to the species provided with axillary cymes of large violet flowers with a campanulate corolla tube and a spread-

ing limb, i.e. to *R. tuberosa* L. and its nearest allies, Nees' American *Ruellia* species will have to be transferred to *Lychniothyrsus*, and become therefore: **Lychniothyrsus ochroleucus** (Nees) Brem., comb. nov. (*Ruellia ochroleuca* Mart. ex Nees, Fl. Bras. **9**: 56. 1847); **Lychniothyrsus tetragonus** (Link) Brem., comb. nov. (*Ruellia tetragona* Link, Enum. Hort. Berol. **2**: 133. 1822); **Lychniothyrsus albus** (Nees) Brem., comb. nov. (*Ruellia alba* Nees, Fl. Bras. **9**: 55, 1847); and **Lychniothyrsus hygrophilus** (Nees) Brem., comb. nov. (*Ruellia hygrophila* Mart. Flora **24**: Beibl. 2: 65. 1841).

ODONTONEMA SCHOMBURGKIANUM (Nees) Kuntze, Rev. Gen. 494. 1891. *Thyrsacanthus Schomburgkianus* Nees, London Jour. Bot. **4**: 636. 1845; DC. Prodr. **11**: 325. 1847. Herb with decumbent shoots and scarlet flowers. Potaro River, Tukeit; on the white sand of clearings at the forest edge, locally frequent, *23044*.

This specimen has the large and thin leaves of *O. macrophyllum* Gleason (Contr. N. Y. Bot. Gard. **282**: 300. 1926) which was collected in the same area, but the shortly pubescent inflorescence and the shorter calyx lobes of Nees' species, to which it is here provisionally referred.

DREJERA BOLIVIENSIS Nees. A specimen collected at an altitude of 200 m. in dense forest at the western end of the Kanuki Mountains in the drainage of the Takuto River (*Smith 3165*) was described by Leonard (Lloydia **2**: 213. 1939) as a new species under the name *Anisacanthus secundus*. The author compares this plant with *Anisacanthus Malmei* Lindau. Of the latter no material was available to me, but it would be worth while to reinvestigate this species, for it is quite possible that this too may prove to belong to Drejera.

Rhacodiscus calycinus (Nees) Brem., comb. nov. *Beloperone? calycina* Nees, London Jour. Bot. **4**: 637. 1845; DC. Prodr. **11**: 423. 1847. *Justicia acuminatissima* (Miq.) Brem. (239). BRITISH GUIANA: shoots and pedicels bronze-green, calyx bright green, corolla scarlet; Yarikita portage, N.W.D. along the trail on brown sand, *F2442*, *F.D. 5178;* Essequibo River, Groete Creek, Kamuni Creek, open spaces in mixed forest, *22919;* Saramacca River, vicinity of Tawa Creek, frequent, forming low bushes bordered by *Montrichardia arborescens 23740;* Tafelberg in high forest at the base of the southern cliffs at Arrowhead Basin, rare, *24480*.

When I dealt with this species in Pulle's *Flora of Suriname* Nees' *Beloperone? calycina* was not yet known to me. The Kew botanists, however, had at that time already recognized that the latter and *Justicia acuminatissima* must be regarded either as identical or at least as very nearly related. Material from British Guiana placed at my disposition by the intermediary of Mr. N. Y. Sandwith allowed me to establish the identity of the two species. That it is here once more referred to Lindau's genus *Rhacodiscus* finds its explanation in the following considerations. The generic name *Justicia* is, as I have pointed out in a paper that is awaiting publication, to be confined either to *J. hyssopifolia* L. alone or to the latter and a group of South African species of which *J. orchioides* L. f. is perhaps the best known representative, and the very numerous remaining species are therefore to be transferred to other genera. The American species with long-tubed red flowers are to be placed partly in *Beloperone* Nees and partly in *Rhacodiscus* Lindau, which differ from each other in the shape of the lower corolla lip and in that of the seeds. In *Beloperone* the lower corolla lip is

slightly wider than the upper one and 3-fid, and the seeds are distinctly swollen, whereas in *Rhacodiscus* the lower corolla lip is much narrower and only shortly 3-lobed and the seeds are flattened. To the character on which the genus was founded, the echinulate pollen grains, I attach no value, for the resemblance between *Rhacodiscus calycinus*, in which the pollen grains are of this type, and *Rhacodiscus secundus* (Vahl) Brem. with pollen grains of the same kind as those of *Beloperone* is so striking that it would be artificial to refer them to different genera.

Rhacodiscus secundus (Vahl) Brem., comb. nov. *Justicia secunda* Vahl, Symb. Bot. **2**: 7. 1791. BRITISH GUIANA: nodes with a red band, corolla and style red, Mazaruni River, Barakara Creek, on sandy soil along the river bank, *C.A.P.6*, (*F.D. 5259*).

In Pulle's *Flora of Suriname* besides *Justicia acuminatissima* five species were dealt with under this genus. Of these no. 2, the violet-flowered *J. carthaginensis* Jacq. was in the paper to which I referred above placed in an as yet unnamed genus in the neighborhood of *Beloperone*, no. 3 and 4, *J. pectoralis* Jacq. and *J. martiana* (Nees) Lindau in a new genus *Psacadocalymma*, and no. 6, *J. obtusifolia* (Nees) Lindau in *Dianthera* L., a name that is to be restricted to a group of exclusively American marsh plants with narrow leaves, axillary spikes and thin, smooth seeds with a dentate margin. The exact position of no. 5, *J. cayennensis* (Nees) Lindau (247) was not yet determined. The circumstance that this species is represented in the collection of the New York Botanical Garden Tropical Expedition of 1944 offers a welcome opportunity to discuss its affinities.

J. cayennensis was originally described by Nees (London Jour. Bot. **4**: 637. 1845) as a species of his genus *Amphiscopia*, but two years later in his monograph of the family (DC. Prodr. **11**: 346. 1847.) Nees transferred it to *Rhytiglossa*. The name *Rhytiglossa*, however, is to be restricted to a number of African species provided with lenticular, finely echinulate pollen grains, and for *Rh. cayennensis* with its flattened, doleiform pollen grains therefore a position is to be found elsewhere. In the terminal position of the inflorescence with its comparatively small flowers, and in the small size of the posticous calyx lobe it shows a rather striking resemblance to the species of the paleotropic genus *Rostellularia* Reichenb. It differs, however, from the latter in the shape and size of the cystoliths, which are not boomerang-shaped but nearly straight and much smaller, in the much wider connective, the ecalcarate thecae, the shape of the lumen of the pollen grains, which in *Rostellularia* reminds one of a sandglass, the entirely hirtellous, not merely comose ovary, and in the distinctly unguiculate capsule. These differences are of sufficient importance to justify the creation of a new genus. On account of the weakly developed fifth calyx lobe I propose for this genus the name *Dyspemptemorion*. So far it is monotypic.

Dyspemptemorion Brem., gen. nov. *Justicearum* neo-tropicarum granulis pollinis doleiformibus parvis, utroque latere pororum serie singula tuberculorum ornatis, inflorescentiis spiciformibus terminalibus, bracteis penninerviis imbricatis, calycis lobo postico magnitudine multo redacto ad *Rostellulariam* Reichenb. accendens, lumine granulorum pollinis ad medium haud distincte constricto, cystolithis haud conspicue curvatis, connectivo lato, thecis utrisque ecalcaratis, ovario toto hirtello, capsula distincte unguiculata ab ea recedens.

Herba gracilis. Folia breviter petiolata, opposita aequalia, cystolithis subrectis parvis sparsa. Inflorescentiae spiciformes, terminales, interdum spicis una vel duabus ex axillis foliorum supremorum orientibus comitatae, floribus inferioribus interdum superpositis. Bracteae decussatae, primum imbricatae, ovato-lanceolatae, basi in petiolum brevem contractae, penninerviae, ciliatae. Bracteolae bracteis atque calyci subaequilongae, angustae, 1-nerviae, ciliatae. Calyx inaequaliter 5-partitus; lobi angusti, ciliati, posticus aliis multo minor. Corolla dilute violacea vel albida, calyce bis vel triplo longior; labia tubo paulo breviora, superius triangulare, rugula instructum, inferius breviter 3-lobatum, palato e bullis duabus parallelis formato, striis notato instructum. Stamina 2; filamenta glabra; antherae connective lato instructae; thecae subglobosae, sese dimidio obtegentes, ecalcaratae. Granula pollinis doleiformia, paulum complanata, parva (25–32 μ longa), 2-pora, utroque latere pororum serie singula carunculorum ornata, lumine ad medium haud distincte constricto. Discus annularis. Ovarium totum hirtellum. Stylus basi sparse hirtellus. Stigma parvum, indivisum. Capsula unguiculata, hirtella, valvulis 2-seminalibus. Semina superposita, complanata, brunnea, muricata.

Distr. in America tropicali.

TYPUS generis: *Dyspemptemorion cayennense* (Nees) Brem. (*Amphiscopia* et *Rhytiglossa cayennensis* Nees).

Dyspemptemorion cayennense (Nees) Brem., comb. nov. *Rhytiglossa cayennensis* Nees, DC. Prodr. **11**: 346. 1847. SURINAM: frequent, annual herb, flowers white, swampy bush above the village of Jacob kondre, along the Saramacca trail, *23882*, June 18, 1944.

(*23883* consists partly of this species and partly of *Psychotria officinalis* (Aubl.) Rausch. The note on the label "peduncles and bracts blue; fruit lighter blue, pedicels reflexed" evidently refers to the latter.)

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TORREYA

REVIEWS

The Cultivated Species of Primula. By Walter C. Blasdale. University of California Press, Berkeley, California. 1948.

Dr. Blasdale has given us a book from which we may learn far more than the taxonomy of the genus *Primula*. It is unique in dealing so thoroughly with the plant, botanically and horticulturally. The introductory chapters discuss the history and methods of classification of the numerous sections of the genus. Biological characteristics are explained and we are taught much of interest and importance as to the possibilities of viable seeds from hybrids, methods of increasing farination, and other features of value.

Then on to horticultural requirements and methods which many readers will study closely. "A fair percentage are no more difficult to grow than pansies" is a welcome statement, since so many gardeners look upon all primulas with the exception of *P. polyantha* and the greenhouse species as well-nigh impossible. "Emphasis should be placed upon the composition of the solution derived from the action of water on the mineralogical components of the soil, rather than the soil itself" explodes the pH theory so important to some scientists. Dr. Blasdale lays much more emphasis on good drainage and says that erring on the side of too much sand rather than too much clay is a safe rule, because primulas have two biological peculiarities—first, rapid transpiration, and second, since frequent applications of water are unavoidable, the importance of free circulation through the soil medium. Shade requirements are discussed and the use of a lath house may explain something of the success of the writer.

From the chapter on growing we move to a monograph of the genus, discussed by treating each section separately, beginning with the primroses and cowslips and ending with the less known; in all between 400 and 500 species. There are a few errors in nomenclature and one or two species are doubtfully placed in their correct section.

In the final chapter gardeners are mildly reprimanded for the limited variety grown in the United States and indeed for the lack of variety of ornamental plants generally.

The book is well illustrated with pages given over to two or more half tones.

This is a book of real value to gardeners everywhere as well as to students of botanical subjects.—JAMES G. ESSON.

Drawings of British Plants. By Stella Ross-Craig. Part I. Ranunculaceae. *pl. 1–44.* Part II. Berberidaceae, Nymphaeaceae, Papaveraceae, Fumariaceae. *pl. 1–22.* London: G. Bell & Sons Ltd. 1948.

These two parts are the first of what is planned to be a work of some importance, its object being to illustrate the species of flowering plants native in the British Isles in 1500–1800 drawings. Each part, dealing with one or more families, is to be complete in itself, bound in heavy paper with a decorative design. In the parts now before us, each species is illustrated by a whole page, bearing from 6 to 14 figures. In addition to a general sketch of the species, there are abundant diagnostic details, with magnifications indicated. It is not intended to illustrate varieties or micro-species.

Miss Ross-Craig is the artist at the Kew Herbarium, and has thus been able to supplement her artistic proficiency with unexcelled facilities for botanical observation. She has had also the willing cooperation of the members of the staff of the Herbarium. Many specimens from the herbarium were examined in an effort to make the plants figured truly representative. Perhaps as a result of such a background, the figures seem the work of a botanist rather than of an artist—though technically no fault can be found with them.

This work should be invaluable to both amateur and professional botanists, and provides a model which might well be imitated in this country.—H. W. RICKETT.

NOTES

The thirty-fifth edition of **The Naturalists' Directory** has recently been published by the Cassino Press, Salem, Massachusetts. It contains names, addresses, and special subjects of study of professional and amateur naturalists of North and South America and some other countries, and a list of scientific periodicals and natural history museums.

Silva of North America, a description of the trees which grow naturally in North America exclusive of Mexico. By Charles Sprague Sargent. This work, long out of print and practically unobtainable at any price, has been reprinted by Peter Smith, 321 Fifth Avenue, New York. The original edition was published at $350, and sets have been sold for as much as $500. The reprinted edition consists of 200 sets, 14 volumes bound in 7, complete with all illustrations. The list price is $200.

Dr. John S. Karling has resigned from Columbia University to become Professor of Botany and Chairman of the Department of Biological Sciences at Purdue University, Lafayette, Indiana. Dr. Karling joined the Torrey Botanical Club in 1924, and served as Vice-President in 1930, Recording Secretary from 1933 to 1936, Corresponding Secretary from 1937 to 1940, and was President in 1941; he has also been Historian since the establishment of this office in 1943.

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COMPILED BY

LAZELLA SCHWARTEN

WITH THE COLLABORATION OF THE EDITOR OF THE TAXONOMIC INDEX

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